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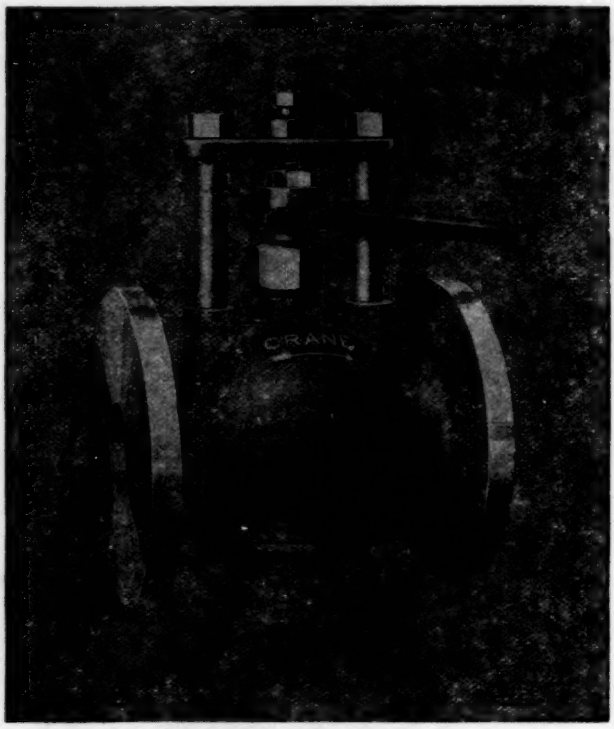

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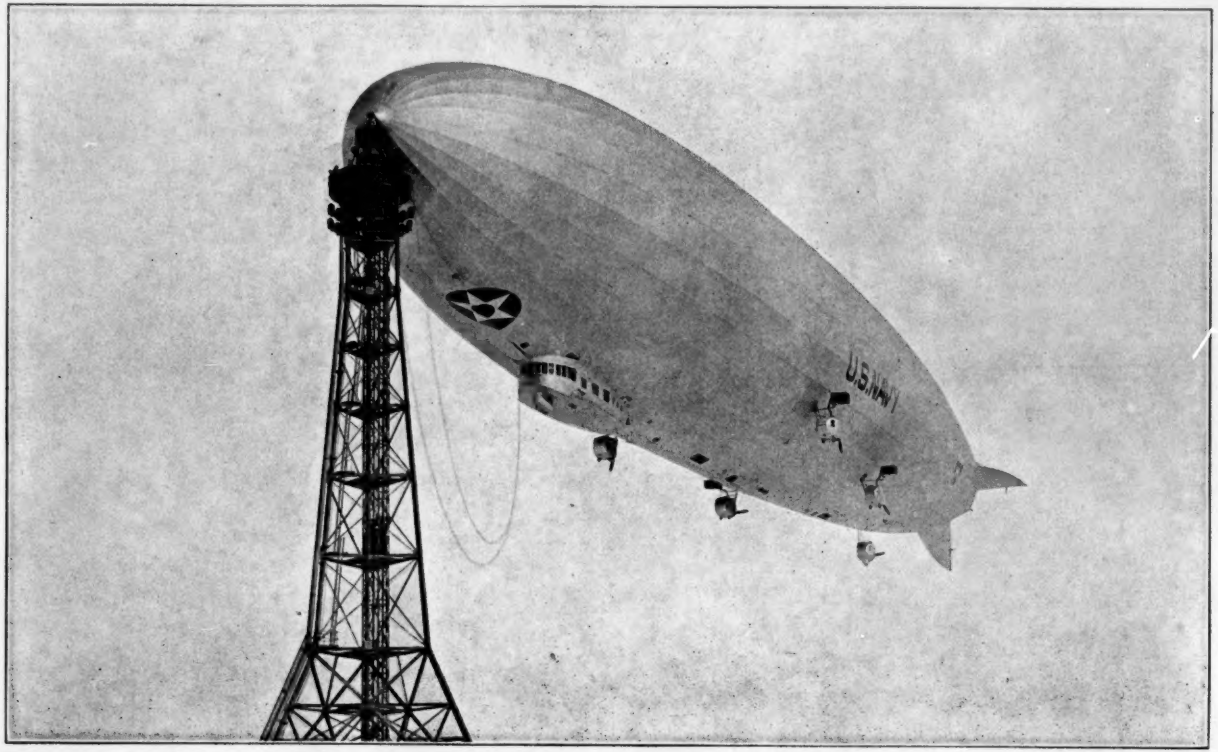

U. S. S. "Los Angeles" at Mooring Mast

Openings along keel are windows to light keel passageway and crew's staterooms. Note the five power cars; two on each side and one on center line aft. The *Shenandoah* has the same number and arrangement of power cars.

U. S. S. "LOS ANGELES" AT MOORING MAST

Openings along keel are windows to light keel passageway and crew's staterooms. Note the five power cars; two on each side and one on center line aft. The *Shenandoah* has the same number and arrangement of power cars.

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VOL. No. 51, No. 4 APRIL, 1925 WHOLE No. 266

PRIZE ESSAY 1925

THE TREND OF NAVAL AFFAIRS

BY LIEUTENANT (j.g.) R. E. KRAUSE, U. S. NAVY

Motto: *"Whither Are We Going."*

EDITOR'S NOTE.—The author, while receiving his education in the high schools and Reed College, Portland, Oregon, joined the Oregon Naval Militia and attended the officers' school for two years. In June, 1917, he successfully passed the entrance examinations to the Naval Academy, but did not enter the Academy. He enrolled in the National Naval Volunteers and was ordered to the Naval Training Camp at Seattle, being afterwards transferred to the Atlantic for duty in the Transport Service. In 1918 he was transferred to the Officer Material School at Pelham Bay, New York, later receiving a commission as ensign in the Reserve Force, followed by a transfer to the Regular Navy, first being commissioned as a temporary ensign and later receiving a permanent commission. His serivce has included both battleship and destroyer duty.

IT HAS been said that "to prophesy for the future the head may be in the clouds, but to provide for the present the feet must be firm on the ground." Yet very often we little appreciate that in order to have our feet firmly on the ground it behooves us also to have our heads in the clouds, so to speak. The Navy is today sorely in need of men of vision—men who can sense out the future—who can give to the Navy ideas which, by well-planned experiment, investigation, research and development, may lead to important conclusions. It is a significant fact that, although America has been distinctly in the lead in the invention of types and weapons of prime importance and in introducing new features

in the field of naval design, our Navy has, generally speaking, lagged behind in their adoption and application. The submarine, monitor and airplane are cases in point. Our inventors found a deaf ear when they brought their ideas before our high naval officials and such men as Fulton and Ericsson, among others, were forced to go abroad for recognition. Too often we have harkened only to the pressure of war necessity, strong political influence, or the adoption of innovations by foreign powers before we saw the light. We have followed where we should have led.

Military men are naturally, and for well-defined reasons, conservative. They have been so from time immemorial. Over and above this fundamental reason we need only to review our history in brief to see why our naval officers have been conservative. The United States has occupied an enviable position as regards isolation, being bounded on the east and west by oceans thousands of miles in extent and on the north and south by relatively weak countries. We have, until quite recently, zealously avoided alliances and foreign entanglements. "Live and let live" was our policy and, except for the Monroe Doctrine, we sought neither influence nor power outside of our country. Perhaps no other one factor has caused as many wars as trade. It is a first consideration in international relations, and peace and war hang in the balance when national interests clash in this domain. In this field our sporadic efforts were of little concern to foreign countries. We, therefore, lacked the urge of the ever-present probability of war that is continuously felt by most other powers, especially by those in Europe. How natural it was for us to sit back and let other nations experiment with original designs of types, and inventions in general; to let them develop new ideas and demonstrate their usefulness all at their expense, and then for us to accept the finished product. On the whole the quality of our Navy has been mediocre. A navy which makes a practice of copying can be nothing more. Navies possessed with strong vitality have always struck boldly forward on new, untrodden ways. Have we not come to the parting of the ways? Can we safely continue to follow?

The isolation of which we were wont to boast has been decreasing relatively as the speed of transportation has been increasing. Where formerly we reckoned a transatlantic passage by

steamship in days, we now do so in hours by airplane or dirigible. The period of colonial expansion commencing with the purchase of Alaska, our penetration of the Pacific and the Far East, and the Caribbean, carried with it increased responsibilities and obligated us to take a new and imperative interest in world affairs. We found, during the World War, that our isolation left much to be desired, since our foreign trade had taken prodigious strides and required protection in all parts of the world. The Washington Conference marked a further step away from our ancient policy of isolation. The Four Power Treaty is the visible proof that our policy of non-entanglement is a thing of the past, although it must be said that it is only the culmination of years of involvement in Pacific and Far East questions. Our trade has built up since 1914 by leaps and bounds until today our combined export and import trade amounts to about eight billion dollars, and most of this is carried in American bottoms. Our war-built Merchant Marine was in a precarious condition after the war when it had to compete with the more experienced European countries but it has survived and will continue to figure as a principal component of the world shipping industry. Our interests are scattered far and wide over the length and breadth of the globe. We are developing keen economic rivalries and by our policy of excluding unassimilable peoples we are arousing racial antipathies. The World War left us in a position of strength, both in military power and in finance, while European countries emerged exhausted. We are aspiring to world leadership and must adapt our conduct accordingly. We must carefully study the international situation and our place in the world. Can we afford to lead in the province of commerce, finance and the rest, but to follow in the study of naval warfare?

We are living in a wonderful age—an era of change. It is a standard remark, and yet, do we fully realize what it means? It seems as though the rate of progress of civilization follows the same law as that of accelerated motion. And, indeed, it should. The greater the store of human knowledge the greater the foundation on which man has to build. When we study the nineteenth century progress of human achievement in material development, in scientific discovery, and in mechanical invention, we are impressed; and if we should array the steamboat, the railroad, the

printing press, steel ships, the telegraph and telephone, the sewing machine, the conquering of electricity, and so forth, against all other similar conquests in the material field of the Christian era up to the nineteenth century, we might very easily decide that the human race had made more progress in this one century than during the entire eighteen centuries prior to it. With the first quarter of the twentieth century almost spent we can look back and see that the rate of human progress has not diminished. We have made the following achievements since the beginning of the twentieth century: airplanes, automobiles, submarines, radio telegraphy and telephony, x-ray, wireless control of moving unmanned ships, wireless transmission of photographs and of power in an experimental stage, and so forth. A survey of the naval situation during these times will show the same results. Let it be our high resolve to maintain the same onward pace of progress. There is no middle ground in the field of naval development, for when progress ceases, decay sets in.

This rapid progress has, of course, tended to diminish conservatism in our Navy as well as in those of foreign countries, but it must be admitted that, in the very nature of things, we are conservative and always will be. It therefore behooves us to be on the alert and utilize our undoubted inventive genius by recognizing demonstrated facts. It is not necessary that a new invention demonstrate its usefulness in war before it should be adopted. No gun of comparable efficiency had ever been used in war prior to the use of the Prussian needle-gun in the Austro-Prussian War of 1866—a gun which fired with such rapidity that it led the Austrians to remark that the "Prussians load during the night and fire during the day," while the Austrians rammed the charge down the muzzle as of old. Prior to the World War, the airplane had not demonstrated its efficiency in modern battle and yet how foolish it would have been if the European powers had not developed it before 1914, timid though such development was. Again we have seen that, during the World War, in no case did the operations of airplanes, airships and submarines have a noticeable effect in the major naval battles; yet is there one with vision so narrow who would deny that all three of these types will fill their niche in the next naval battle?

Preparation for war is a business—and a serious one. When

war was thrust upon us in 1917 all the industries and resources of this great country were called into play; the best brains were mustered to tackle various problems, with the result that the decisiveness and speed of our rush to the Allies' assistance was a surprise to the world. The American people found an immense satisfaction in their strength. They felt comfortable, and, with the war over, decided that armaments were unnecessary and summarily called for disarmament. The point is that the importance of scientific preparation for war has not been pressed home to the American people. Americans are proverbially careless students of history. They apparently have no conception of what the prepared and powerful British Navy meant to us. How the protection it afforded enabled us to retrieve the mistakes and neglect of previous years in feverish haste and at appalling cost! One has only to think of the destroyer situation. Before the war the General Board recommended a policy of building four destroyers for each battleship, and in the light of the experience of the World War, we know that this was little enough. But invariably Congress cut the number of destroyers to one or two per battleship. Why? Because the battleships appealed to the popular mind and congressmen felt that they represented greater value to their constituents. Cooperation between the Army and Navy, which is of such vital importance, was virtually nullified when, in 1915, by order of the President, the Army and Navy Joint Board was forbidden to hold any further meetings for the apparent reason that it was feared that the Army and Navy might cooperate actively for the preparation for war. Let us think for a minute of what vast moment preparation for war really is. Adequate preparation may avert war or lack of it may induce war. Preparation for war may also cause, or at least promote, war in those countries where the military factions have strong political influence, as in Germany before the war, or in Japan today. Adequate preparation will win a war with minimum loss in lives and money. A nation may win a war in spite of inadequate preparation but with maximum loss of lives and money, or it will lose the war with all the lives and money it has cost. Great indeed is the importance of preparation and, as war becomes more complex and specialized, its effect will increase correspondingly. Under modern conditions it may be assumed that the fundamental conduct of the first two years of a naval war

in which we may become engaged will be predetermined by what preparation we have made in time of peace.

Until a few years ago the United States Navy did not have a policy which provided for the future. We lived from year to year, building such ships as Congress appropriated money for, and built them without a definite policy. We now have a policy and, as a temporary expedient, it is doubtless of great value. It is a plan for building and maintaining a well-rounded navy. It provides what types and how many we should maintain in commission, what types and how many to build, and so forth. But is it not, after all, a "makeshift" arrangement—a bolstering up here and a filling there—a nice piece of patchwork? What we need is a carefully worked out plan of a new navy, built to a purpose, adequate and suitable to fulfil the functions assigned to it on the water, below the water, and above the water. On this point we can learn a lesson from Germany. Her navy was built with the definite object in view of disputing the British supremacy of the seas. Realizing, therefore, that the eventual struggle must take place in the North Sea, the German ships were built with moderate fuel capacity, crowded living quarters, and, in general, other characteristics premised on the assumption that they would fight near their home bases. The British ships on the other hand were built with large fuel capacity, comparatively comfortable living quarters, and so forth; in short they were built to fight anywhere. Germany took full advantage of this point and was therefore enabled to put greater fighting power into her ships, ton for ton, than Great Britain.

A study of the parallel development of the French and German Navies between 1900 and 1914 affords a striking example of the difference between a navy built on a scientific policy and one with no policy. The French naval program during these years was a succession of spasmodic efforts and undirected development—a navy built by "fits and starts." During the same time Germany, under the able direction of Admiral von Tirpitz, created a fleet which was not only far more powerful than the French but almost on a parity with that of Great Britain. *This was accomplished with a smaller annual expenditure, with inferior industrial backing, but with a unity, a direction, a perseverance toward a set goal, and a will to win.* Superior engineering, construction, equipment and

finances are apt to be of little use unless they are directed by a definite and carefully-planned naval policy.

It is the legitimate province of Congress, after listening to the Navy's plea as to what appropriations are believed to be necessary, to decide what the nation can and should afford. Only too often Congress has appropriated for one type in preference to another and in general disregarded the expert opinion which it had at its command. We have already cited the instance of the destroyer situation before the war and it is only one of a number with which our history is replete. There have even been instances when Congress has altered the military characteristics of our ships as recommended, as when Congress, with the "too many eggs in one basket" idea, materially reduced the size of the battleships and, again, when they insisted that the after-cage mast be placed between the funnels. On the whole, however, we have fared better as regards the military characteristic than as regards numbers. Had Congress, in order to reduce expenditures, cut the numbers of all types in proportion, it would have left us with a small but well-rounded fleet instead of the battleship-topheavy one which we had in 1917. Perhaps the worst example of congressional interference has been in the navy yard situation and it would indeed be comical were it not for the serious aspects of the case.

In this respect the Navy has been a "political football." Every seaboard state has fought for its own navy yard and, if its harbors were not such as to warrant a navy yard, it must have at least a destroyer or submarine base. Each state must have its own individual protection; but what is probably the greatest incentive is that the success of congressmen, according to the mass of their constituents, is measured by the amount of appropriations they can secure for their respective states. The result is that we have today not less than twelve navy yards and naval bases, exclusive of destroyer and submarine bases, and so forth. Only three of these are located on the Pacific Coast and not one is fitted out as a fleet base. The creation of the Charleston Navy Yard affords an interesting example of congressional logrolling. The Navy was ordered to appoint a board to investigate and report on the relative merits of the Charleston and Port Royal sites for the establishment of a navy yard. The Navy was not even asked whether a navy yard was necessary at either site. The board investigated as

directed but reported that both sites were unsatisfactory, although Charleston was the better of the two. Over and above this report, though using such parts of it as stated that the Charleston site was the better of the two, the necessary legislation was passed for the establishment of the Charleston Navy Yard.

Another more recent example was when the naval board recommended the establishment of a fleet base at Alameda, California, which would be able to provide fleet facilities, such as docking, storage, anchorage, etc., for the entire fleet. The board recognized that it was impossible to provide such a base centered at Mare Island, due to the extremely limited anchorage and the silting conditions which requires continual dredging to keep even a narrow channel open. This proposition, therefore, meant the immediate transferring of a large part, and probably the eventual transferring of all the functions of the Mare Island Yard to Alameda, and the consequent depression of business for Vallejo, which exists for the navy yard. The people of Vallejo, therefore, fought this proposition and secured such political backing in Congress that the measure was defeated. It must in all fairness also be said that there were certain naval officers who supported this group. The rejoicing of the populace would have led one to believe that we had won another battle of Manila Bay had one not known the issue. And we are still without the fleet base.

Navy yards and, in fact, the entire shore establishment of the Navy exists for the sole purpose of serving the fleet. Efforts have been made time and again to reduce the number of navy yards which do not add to the efficiency of the fleet; but in general they have seldom met with success and in all cases have been strenuously resisted. The Navy itself, it must be said, has been lukewarm in pushing for the needed changes for fear of antagonizing the people and their representatives in Congress and thus losing supporters for other naval legislation. There is, indeed, a great deal to be said in favor of this argument, but when all is said and done, has it given us, or can it ever give us the means to attain the highest efficiency? And nothing but that should satisfy us. Can we afford to compromise efficiency at this stage of our history?

Public opinion runs this country, and daily its weight is being felt more heavily. This is a fact which we must appreciate and

adopt our conduct accordingly. The Navy belongs to the people of the United States and they want it to be a first class one, if they can have it at a reasonable cost. Would it not, therefore, be the part of wisdom to make an open breast of naval affairs and take the people into our confidence? What would be the weight of the voices of a few thousand Vallejoites or those of any other place where, by force of necessity, the Navy is forced to change its plans when over one hundred million people demand that efficiency be served? Would not, perchance, even the citizens whose personal interests had been injured admire the Navy for its stand? The American people stand for efficiency in business and are intolerant of anything that interferes with it. Would they not feel the same way toward the Navy, if they knew the true state of affairs? How have we catered to public opinion? What does the average man know about the Navy? During the last few years he has read accounts of the Honda disaster where we lost seven destroyers; he has read about the turret explosions in the *Mississippi* and the *Trenton;* he has read, mainly, accounts of uninformed writers, who see no reason for the existence of a Navy when we have airplanes; and, finally, he has read accounts that our Navy is hopelessly inferior to foreign navies and outclassed in every branch. What interest can we expect the average man to take in his Navy, unless it is an interest in scrapping it? Is he not apt to say, "Well, if the Navy can't do any better than that with the three hundred million dollars that we appropriate annually, why waste any more on it?" What are we doing to counteract the insidious propaganda which is being disseminated from various sources? Millions of people read the comments of uninformed writers who have long carried on propaganda for the air service at the expense of the surface navy. The substance of a recent comment was as follows: "A battleship costs $45,000,000. For that sum you can build 2,000 fighting airplanes." By the term "fighting airplanes" is apparently meant bombers or torpedo planes for it goes on to say "any two of which can sink that battleship." The above figures are not even fair average initial costs of a modern battleship and a bombing or torpedo plane. But be that as it may, the great discrimination made is that it goes no further. The reader is left with the impression that one battleship and 2,000 airplanes

represent an equivalent in cost. It does not consider the comparative maintenance, depreciation, and so forth. Public opinion has the impression now that surface ships are "passé." What are we doing about it? What are we going to do about it—nothing but study the problems, form our opinions, and then keep them to ourselves?

The Washington Conference and Its Effects.—The Washington Conference for the Limitation of Naval Armament has been heralded as a signal success. It is not the intention of the writer to go into the political aspects of this question but these are so interwoven with the trend of naval affairs that complete separation is impossible. In general, we may say that the conference was a success not so much from the standpoint of naval armaments, which was its primary purpose, but rather in that it pointed the way toward settling disputes and removing or at least decreasing friction in the future. Concretely, it removed the immediate danger of war in the Pacific. From the standpoint of limiting competition in naval armaments, not much can be said for the success of the conference. True, it limited the size and number of battleships, the size and total tonnage of aircraft carriers, and the size and caliber of guns of auxiliary vessels, and so forth. This has enabled us to reduce our appropriations considerably but it must be remembered that we have not maintained our treaty strength. To bring our Navy up to the treaty ratio would require an outlay that would be staggering. It was fondly hoped that the costly competition in naval armaments would be eliminated and the public believes that this has been accomplished. But how utterly impossible this is! The elimination of competition must come from within, and the spirit of the people must be changed. How is it possible to limit competition in naval armaments when we have competition in commerce, in finance, and in every other walk of life? We can limit the size and number of battleships, but we have not eliminated competition; we can limit the size and number of auxiliary vessels, but we have not eliminated competition; we can limit the number of officers and men, but we have not eliminated competition. Even if it were possible, the elimination of competition would be highly undesirable, for when competition ceases, decay sets in.

We in this country have felt a lull in the competition, due to the

fact that we scrapped our immense battleship building program. Until very recently battleships have always appealed to the popular mind as the essence of naval power and with the stabilization of the ratios in this element of fighting strength the people were lulled into a false sense of security. Until very recently Great Britain, it is true, was taking a more or less complete respite in naval development, and, judged by her treaty ratio, she could afford to do so. Her fleet is fairly well-rounded, the battleships whose ratio is fixed by the treaty forming the nucleus. Japan has been continuing and enlarging upon her development of auxiliary types. France has made prodigious strides in the development of her air force.

Perhaps it is only coincidence that, except for aircraft carriers, the battleship, the type in which we were bidding for world supremacy, was the only type to be limited by the conference. We had that to bargain with and we sacrificed it in order to make the conference a success. The ratios as established are fair enough if we will but hold to them. In armaments we have always hesitated to go the limit, and it is also probable (as is borne out by the trend since the conference) that the other powers will maintain their ratios at par while the United States will go backward. That the United States will be governed by the letter of the treaty goes without saying and she is setting the other governments an example by abiding by the spirit of it as well. But here is where we will be at a disadvantage, since the other powers, at best, will conform to the letter alone. The American people are idealistic and little realize that love and good will are not controlling factors among nations. While we are debating as to whether we should increase the elevation of our guns and while Great Britain is informing us that it would be contrary to the treaty, Japan has been going ahead and doing that very thing. But even this, apparently, does not justify us in going ahead and doing the same for our battleships.

As it will be remembered, the non-fortifications agreement of the Pacific is a concession we had to make to Japan in order to obtain her consent to the 5-5-3 ratio. Although it is limited by the terms of the agreement to a period of fifteen years, it is tantamount to a recognition of Japan's Monroe Doctrine. Japan will gradually assume the attitude that this concession is a recognition

of her dominance in the Far East, and we may be sure that when the agreement has run its course Japan will occupy a far stronger position than now. Should we undertake to increase our fortifications, it is most probable that Japan would consider this as a threat of war, so, whether the non-fortifications agreement is renewed or not, the possibility that the Philippines and Guam will ever be adequately fortified in peace is extremely remote. Therefore, in our future naval development program we should bear this in mind and be governed accordingly.

Prior to the conference it was generally recognized that there was a greater net return by avoiding extensive repairs on battleships and devoting the money to new construction. This, of course, no longer applies since the battleships which may be built are now specified by the treaty. It becomes, therefore, a necessity to maintain our battleships in topnotch condition. The competition, in other words, has shifted from one of numbers to one of quality.

What is the future of the treaty limiting naval armaments? It is important that we keep in touch with the international situation so as to enable us to lay our plans as far in advance as possible. What were the conditions when the treaty was signed and what are they likely to be when the fifteen years have expired? When the nations met at the Washington Conference the time was extremely propitious for its success. The main points to be borne in mind are these: the nations of Europe were exhausted after the terrific struggle of the World War; Japan, which had overreached itself by its grasping tactics and attitude during the World War, found sentiment unitedly against her, and had to make heavy concessions, and, finally, the United States, which alone of all nations was in a position to make vast additions to its armaments, was working toward an ideal and was willing to forego the chance of being invincible on the sea. What will be the conditions in 1936 when the treaty terminates? Will the treaty continue in force as it is, will the ratio be changed to suit changed conditions, or will it be impossible to arrive at a ratio which will be mutually agreeable? It is now three years since the nations met at Washington and we find that the conditions have changed to such an extent that were the conference to be held at the present time it would be far harder to come to a mutual

agreement. Great Britain and France were still on fairly good terms in 1921 but since then they have been steadily growing apart. By 1936 we may expect to find that the European nations who participated in the World War will have fairly recuperated. Great Britain, with her enormous trade and her progressing dominions, has considerable recuperative power; France, through her frugal and industrious people, will work herself back into a position of power, although it must be admitted that she is on the decline, which was apparent before the World War. Previous to the war it was generally recognized that the Germans as a race were as virile as any on earth. They were set back to second-rate power by the disastrous results of the war and no doubt it will be many decades before they again take primary rank. That they have already begun to come back is unquestionable and France is looking askance at their development. Whereas in 1914 France was backed by powerful allies, she now stands alone, and she still remembers how overwhelmingly superior Germany was as compared to France alone. France will look to her arms and well she must. Russia is in the position of a young giant who does not know his strength. True, she is not a naval power, but she is capable of tremendous development and her growth as an industrial and military power will have its influence on the naval position of other countries. If Japan continues during the next twelve years the development which she has shown in the past, she will be in a far stronger position than she was in 1921. The dominance of her *kultur* in the Far East—the goal toward which she has been striving—will then probably be a fact. Other nations, also who are not now parties to the treaty will undoubtedly have made great strides in their naval armaments; as for instance, Brazil, Argentina and Chile, in addition to Russia and Germany. It appears probable, therefore, that in order to make the treaty effective other nations will have to be included in the limitation agreement. Will the contracting powers be satisfied with the present ratios of strength? The United States probably will, Great Britain and Italy may, Japan probably will not, and France most certainly will not. The chance that a new set of ratios, satisfactory to all, will be arrived at is small indeed. With the possible exception of the attitude of the United States, all of the factors that made for success in 1921 will have disappeared. In

addition, there will be other powers whose ratios must be fixed and that alone will greatly increase the difficulty. It seems, therefore, that the treaty will go by the board in 1936 and it behooves us to study the future development of those types of ships and weapons which the treaty restricted.

Under the terms of the treaty, battleships are limited in size to 35,000 tons and the caliber of their guns to sixteen inches. This represented a tonnage slightly larger than newest battleships completed about 1921, with the exception of the *Hood* which displaces 41,200 tons. The *California* of 32,300 tons, and the *Nagato* of 33,800 tons were both completed in 1921. The *Hood* represents a hybrid type between battleship and battle cruiser, and it is safe to say that the design would not have been perpetuated. In order to keep pace with the growing demands for greater armaments, armor and speed, it was necessary gradually to increase the displacement. It is safe to say that all battleships built under the treaty will be of maximum displacement, as indicated by the *Rodney* and *Nelson* which Great Britain has laid down. The following characteristics may be taken as a conservative estimate of the treaty battleship; displacement 35,000 tons, length 700 feet, breadth 104 feet, draft twenty-eight feet six inches, speed 23 knots, main battery nine 16-inch guns in triple mounts, secondary battery twelve 6-inch guns, anti-aircraft battery ten 3-inch guns, armor on conning tower and turret faces sixteen inches, armor on sides (max.) fourteen inches, protective deck five to seven inches. It is safe to predict that, prior to 1936, our constructors will find difficulty in incorporating in new battleships all the latest requirements in armament, armor and speed, especially on account of the unsatisfied demand of the battleships for protection against aircraft and submarines. The potentialities of these latter have not yet been exhausted but so far as can be foreseen at present the battleship will probably survive the perils of aerial and submarine attack. No doubt it will require considerable modification as time goes on and other types develop apace. It seems quite certain, therefore, that if the treaty continues after 1936 the powers will increase the displacement limitation. Similarly, the increase in size of main battery guns is apt to be halted only temporarily by the treaty limitation of sixteen inches.

There has been considerable talk about calling a new conference for the purpose of limiting naval auxiliary craft and aircraft, all of which types are unrestricted at the present time. Congress, in fact, added the suggestion to the last two naval appropriation bills. The President, however, has not acted on them for very good reasons. As has already been shown, the time was propitious when the Washington Conference met in 1921 for a successful culmination. The battleship ratio was fairly easily adopted because the United States stood ready to sacrifice the battleship supremacy which lay within her grasp and because Japan had been placated with the non-fortifications agreement. However, when it came to discussing auxiliary craft, the case was different. The conference soon recognized the insurmountable difficulties and abandoned all efforts along this line. Today, there is considerably less chance that such limitation could possibly be agreed upon. France and Great Britain have gradually become estranged. During debates in the French Congress their dissatisfaction with the results of the Washington Conference were openly aired and it was plainly brought out that France would be averse even to discussing any further scheme of naval limitation. Japan has become embittered by the brusque action of our Congress in passing the exclusion act. Japan's naval policy since the Washington Conference has aroused considerable misgivings, not only in the United States but also in European countries. The United States —after abandoning her battleship building program—and the other treaty powers have been taking a more or less complete respite from naval building, but Japan has been continuing her tremendous development of auxiliary types which were not limited by the Washington Conference. Then, too, it is doubtful whether the United States and Great Britain could agree on the question of limiting auxiliary types. Secretary Hughes proposed at the Washington Conference to extend the 5-5-3 ratio to other types as well as battleships, but Great Britain objected to this on account of the necessity of guarding her long trade routes. Could and would we be satisfied with anything less than parity with Great Britain? It has been demonstrated that, unless there is probability of success, it is much better for international relations not to call a conference at all rather than to run the risk of failure. In considering aircraft there is this to be borne in mind—

that military and naval aircraft are not yet sufficiently specialized and differentiated from commercial aircraft to make such limitation really effective.

The treaty forbidding the use of poison gas in naval warfare is still in abeyance—France being the power which has withheld approval. Judging by the disapproval voiced by French statesmen, it is doubtful if that country will ever ratify the treaty and it is not under consideration at the present time. Even if it should be ratified it would be a doubtful benefit to humanity. It is an undisputed fact that both the Allied and the Central powers overstepped the bounds of international law, due to the pressure of war necessity. Where the rights of neutrals are involved belligerent nations are apt to tread more cautiously for fear of adding others to their foe. Such would not be the case in the use of poison gas, where the foe alone would feel the infringement. It is not hard to imagine any one of a number of foreign countries who would violate this treaty as well, if, pressed by war necessity, they saw a means of gaining an advantage over their adversary. The nation which cherished the high ideals would be at a disadvantage.

As to Organization.—An organization to be efficient must be centralized, and, in general, the more strongly centralized the more efficient it is apt to be. The organization of the German Navy Department before the war was strongly centralized, as is that of Japan today, and in both the efficiency displayed is largely due to this fact. Similarly, the government of Germany before the war and that of Japan today are strongly centralized and this is a vital factor toward the successful prosecution of any war.

The government of the United States is not strongly centralized under normal conditions but in time of war the President can and would assume the necessary powers to aid in the centralization. Our Navy Department is poorly centralized and even in time of war it could not efficiently prosecute a war of first magnitude.

The Secretary of the Navy, in whom, under the President, all authority is vested, is a civilian. From a technical point of view this is, of course, in itself an argument against efficiency, but under our form of government it is, no doubt, for the best. The Secretary of Navy represents the people and in this country the voice

of the people should and always will dominate. The Secretary also serves as a valuable connecting link between the people and the Navy. He is our best spokesman becauses he understands the civilian mind. He can, in general, approach Congress with greater success than could the naval officers. Sometimes the man who is the best politician has the best success when it comes to dealing with Congress, as, for instance, Josephus Daniels. The latter aroused much friction and was under constant attack from naval officers because first and foremost he was a politician and was inclined to view the Navy from that standpoint.

Previously, it was the policy to look upon the office of the Secretary of the Navy as a political position. No qualifications from a naval point of view were necessary. Our last two Secretaries have been not only civilians but civilians who had an interest in the Navy. Secretary Denby saw service in the Navy and the present Secretary is a graduate of the Naval Academy. They both understood the naval mind and have its interests at heart. The people in general have expressed their approval of this policy and it is likely that our future secretaries will be required to have an interest in the Navy. This will most certainly work for greater harmony.

Our government structure is founded on the principle of co-operation and our Navy Department is similarly modeled. It reduces direction to a minimum and requires cooperation to the maximum. The American people lend themselves to this form and it is to this fact that we must attribute the harmoniousness with which our states are moulded into one whole. Prior to the late war we were fairly well satisfied with our system of departmental organization but we found that it left much to be desired in the acid test of war. The founding of the Office of Naval Operations was certainly a step in the right direction. There are, however, two fundamental flaws; one is that the Chief of Naval Operations is powerless to do anything except routine work without the consent of the Secretary of the Navy; and the second is that the bureaus are not directly subordinate to the Chief of Naval Operations. The latter has not the power to direct that he should have. He is really an adviser to the Secretary and the power of decision rests with the latter. This is as it should be in time of peace when the civil voice directs;

but in time of war when diplomacy has failed and the military is called upon to defend the country, should not the final decision as to how the war shall be conducted be left to the military?

The Chief of Naval Operations should have a staff, adequate and capable of directing the naval end of a war. In short, we should have a general staff of which the present Chief of Naval Operations should be chief. The term "general staff" is a sort of bugaboo to the American people and seems to convey the idea of something "Prussianistic"—something that would be a menace to American ideals, but, after all, it is simply an organization of naval experts who can direct the Navy's efforts toward a set goal with maximum efficiency. The chiefs of the bureaus should be members of this staff. Modern war is no longer a detached operation of the nation's military forces but it has become the business of the entire nation. Every effort must be bent toward the accomplishment of that end. Not only must naval operations receive expert direction but the thousand and one activities connected with the Army and the industrial life of the nation must be coordinated and guided to serve to the best advantage. During the World War super-agencies were appointed by the President to control important factors. This is the logical field of the general staff.

Until comparatively recent years the battleship force was generally regarded as the Navy, and for this reason a battleship was invariably designated as fleet flagship. Such ships as the German *Friedrich Der Grosse* and *Baden,* the British *Queen Elizabeth* and *Iron Duke,* and our *California* were designed and constructed as fleet flagships, although primarily they were to be ships capable of taking their place in the line of battle. The World War demonstrated the importance of the battle cruiser and the light cruiser. The effect of destroyer torpedo fire at the Battle of Jutland was a revelation. Since then the fleet submarine has been evolved and in the next naval battle that type will have to be reckoned with. Aviation with the fleet has made great strides and it is certain that the commander-in-chief will have to give serious consideration to the air forces in the next naval battle. It is apparent, therefore, that whereas he formerly had to depend on his battleship force for the decision, he now has a complicated battle organization composed of many factors—every one of which

has its niche to fill. It is obvious that by staying with the battleship force his vision will be narrowed and he will have difficulty in obtaining a true perspective of the battle situation as a whole. It is for this reason primarily that the army in time of battle establishes its headquarters well to the rear of the fighting line.

At Jutland both the British and the German commanders-in-chief used battleships as their fleet flagships and these were stationed approximately in the middle of the first third of the battle line. This position was considered as being the best for observing any possible development in the battle and also for distribution of signals to the fleet. Neither of the commanders-in-chief was able to size up the general situation prior to the contact of the battle lines, and this in spite of the fact that the scouts had clashed hours before this and contact reports had been received. They were, therefore, forced to accept a situation, the development of which had passed out of their control. The use of smoke and, in general, the low visibility seriously restricted their fields of vision. The tactical use of smoke screens by destroyers and airplanes has been almost entirely developed since the battle of Jutland. The next naval battle will witness their extensive use and the possibility that the commander-in-chief will be able personally to supervise the combat is extremely remote. He must, therefore, depend upon communications for his information and he would most certainly be able to get faster and more reliable communication if he were stationed out of and behind the battle line.

Recently we have made the U. S. S. *Seattle* our fleet flagship and, as a makeshift arrangement, this is satisfactory. The ideal fleet flagship, however, will have certain functions to fulfil and she should therefore have certain definite characteristics. She should be of sufficient size to provide for the following: Quarters for the commander-in-chief and staff, space for administrative offices, plotting room, game board room, conference room, and so forth; also adequate radio facilities for multiple sending and receiving. She must have facilities for carrying, launching, and, if possible, receiving aircraft in sufficient numbers for observation and protection. She must be seaworthy and steady, of high speed and large cruising radius; she should have an armament designed

to protect her against isolated cruiser, destroyer, submarine and aircraft attack, and moderate armor protection.

The late war demonstrated clearly that in order to win a modern war of the first magnitude it is of fundamental importance to organize Army, Navy and industry for efficient cooperation. The Army and Navy, indeed, are merely units of a larger organization—the fighting forces. Historically, in most major operations of these two services cooperation has been of a low order, and the separate efficiency of each service has been of little value in the net result. Jealousy, lack of understanding and knowledge of the sister service, and many other causes may have stood in the way of effective cooperation, but perhaps the most fundamental cause has been the lack of cooperation at the source; that is, in the War and Navy Departments. Plans of the two services have frequently been at variance, and were often drawn up without the least understanding of the problems of the other service. One of the most glaring instances of non-cooperation in history is the British conduct of the Dardanelles campaign in the World War. It is strange that Great Britain had not learned her lesson, considering the fact that she had been conducting such operations for centuries. The cause in this instance may be found mainly at the source. There was a distinct lack of cooperation between the War Office and the Admiralty, and the British War Cabinet, which governed the policy, was weak and vacillating in its decisions. On the other hand, the combined operations of the Japanese in the Chinese War and again in the Russian War are examples of close and effective cooperation.

During President Taft's administration the United States established the Army and Navy Joint Board, and although it has gone through certain stages of decrepitude it is today a most important factor in the organization of our fighting forces. It is composed of high ranking army and navy officers and its function is to furnish professional advice on the two services to the President through the Secretaries of War and Navy. It is purely advisory and has no power of direction. No real effective cooperation can be ours until our War and Navy Departments have a common professional superior; and the latter should be a joint staff, or board, if you like, which would coordinate our efforts in the preparation and execution of our war plans. It

should also be the duty of such a joint staff to plan the industrial campaign, which will be a factor of vital importance in any major war of the future.

For years it has been the policy for the Naval War College and the various army schools to exchange officers and, in general, to keep in close touch. The two services are working together in many ways with mutual benefit. They have never understood one another better than today and where they have cooperated it has been with harmony. This policy should be continued and extended. It is a vital connecting link which gives knowledge and understanding of the other service. The problem is, after all, not so much one of organization as one of education.

As to Personnel.—Napoleon said: "In war, the morale is to the material as three to one." The American people, notoriously poor students of history, were rudely awakened when the experiences of the World War were pressed home to them. They thought the Navy meant ships; they thought that superior numbers or superior quality meant victory. It must be said that the Navy also entertained this sentiment. Personnel was supposed to exist for the material. Material things were uppermost in the naval mind. The World War vindicated Napoleon's dictum. The tremendous factor of morale in the present day conduct of war was amply demonstrated. We can still feel the spirit of victory when we repeat the words of the French at Verdun, "They shall not pass."

We have discovered that the Navy has a soul—that it has a spiritual side which is major in importance, and, in so doing, the Navy has found itself. We were as a man groping in the dark; he feels to a certain extent but his vision is blurred. He cannot see himself in his true relation to his surroundings. In recent years the curtain has lifted and we can see. What? First and foremost, that man is greater than his creations. The finest ships are so many tons of cold steel unless men drive them. A high order of intelligence and efficiency among the higher officers is no longer sufficient. The modern man-of-war requires skilled men in many branches to operate its complicated organisms and to make its movements coordinate with those of the fleet. They must not only be trained and efficient but also imbued with a high morale. We can further see that our officers and men are what

we make them, and finally that we, individually, have the divine spark within us to make ourselves.

It, therefore, devolves that the training of men, and of himself first, is the highest duty of a naval officer. The best training efforts are of little avail unless backed by the force of example, which is by far the most potent influence wielded by man. In general, we may say that the officers of the Navy set its tone. The men are what we make them. If we are trained, efficient officers of high character, our men will tend to be likewise.

Since it is a fact that no stream can rise higher than its source, it is well for us to first look into the situation as regards ourselves. The founding of the Naval War College marked an epoch in the history of our service. The need of instructing our officers for higher command in the conduct of modern war—its strategy, tactics and logistics—was recognized. That these subjects had been previously disregarded cannot be said, but they had been neglected. Such officers as had studied them had formed their own opinions and conclusions—individualistic and impressionistic. There was no service doctrine. The War College has done much to fill this void and has especially assisted in training officers for higher command. In addition, for the instruction of the line officer personnel, we have the postgraduate school which instructs a limited number in technical material subjects and also the recently established junior war college course to train officers for duties in command. We have, indeed, done little in the education of our officer personnel considering the strides that have been made in material development. Engineering, ordnance, communications, fleet tactics, and so forth, have developed to such an extent that the average officer today knows something about all of them but is far from proficient in any of them. As our material develops, as our types of ships and weapons increase, and as our fleet tactics develop through one, two and three planes, so also must our educational facilities increase. Naval officers of no other naval power are required to cover the scope that we do and no other offers fewer opportunities for education. In general, the Japanese place the greatest emphasis upon naval education and put their officers through periodical and progressive courses of study. We should have not less than three general schools for line officers. For lieutenants (junior grade) with about five

years of commissioned service, we should have a one-year course in general line duties. For lieutenants and lieutenant commanders we should have a one-year course for duties in command. For commanders and captains we should continue the present one-year course at the Naval War College for training in higher command. In addition, of course, we should continue the present postgraduate courses for specialized instruction in technical subjects. The Bureau of Navigation has made recommendations for a complete and progressive system of instruction but has not been able to put it into effect on account of the shortage of commissioned personnel. This is doubtless a valid reason but the condition will never be remedied unless we take drastic action and whole-heartedly and unitedly push for the things we absolutely need.

Realizing, as all naval powers do, the tremendous importance of commissioned and enlisted personnel to a navy, it is rather surprising that the Washington Conference took no steps to regulate naval personnel. No doubt it recognized the difficulties attendant to any such attempt. One such attempt was made in the last century and its limitation was virtually nullified. After the peace of Tilsit in 1807, Prussia was allowed an army of only 40,000 men. Scharnhorst reorganized the army and instituted what is known as the "Kremper" system, by which recruits were inducted, trained intensively for a few months, then discharged, and new recruits enlisted in their place. In this way Prussia trained and organized about forty battalions, in addition to her standing army of 40,000 men.

Since the treaty takes no cognizance of personnel, it is apparently left to each power to decide for itself. Japan maintains an officer and enlisted personnel considerably in excess considering its establishment of ships. A considerable proportion of its officers are on shore under instruction and, in general, all ships are overmanned. Her staffs are also abnormally large. In this way where we would have to call on partially trained reserves and untrained civilians, Japan can meet any sudden expansion by drawing on her surplus active complement. This is a situation which demands attention, for if we are to maintain our ratio of 5-5-3, we must do so not only in ships but also in officers and men.

We are living in an age of specialization. In all branches of civilian professions so much progress has been made that it is impossible for any one man to keep up to date in all phases of his chosen calling. Within comparatively recent years we have witnessed a revolutionizing change in the medical profession, for instance. Where formerly we had a man who was able to advise us concerning any part of our anatomy, we now have numerous specialists covering the same field. One takes the eyes, another the heart, another the liver and kidneys, another is a diagnostician, another is internist, and so on almost without end. Why? Because our knowledge of all these various organs has increased to such an extent that one man cannot keep posted in all departments. Intimate and accurate knowledge is, nowadays, demanded of our physicians. In our naval profession we have also witnessed an unprecedented development in all its varied branches but, unlike our physicians, we are still trying to master it all. We must cover a number of subjects—any one of which would be considered a man's job. Perhaps the situations are not parallel but we must recognize the fact that a point can be reached when the officer cannot keep up in his profession. It is the writer's opinion that the time has come when we should take steps toward dividing the load, notwithstanding the well-known advantages of the present system. Most officers come to their new assignments in an unripe condition. They spend perhaps a year in learning their new job, and when that is well in hand it is time for the next one. Most foreign countries have recognized this situation and have segregated the engineering department. This is, no doubt, the logical one. Close harmony and cooperation must, however, be provided for. Both engineering and line students should go through the same course at the Naval Academy and for the first five years of commissioned service should serve both on deck and below in the engineering department. Then those that elected engineering duty would be sent to the engineering school for one year's course of instruction and the others would be sent to the school for general line duties.

One of our greatest difficulties in recent years has been in the shifting personnel situation. Continual transfers, discharges and desertions have disrupted our organizations and we have in most instances not advanced beyond the stage of elementary training.

The modern man-of-war requires a personnel—intelligent, efficient and trained to work with close cooperation. This can only result after long training together. We pride ourselves on having a superior type of enlisted men but who would be so bold as to say that they can attain the same proficiency as the men of foreign navies with their seven to twelve-year enlistments. We are obtaining a large percentage of reenlistments and that helps but it does not fill the bill. When the man is discharged the organization is usually disrupted, even though the man does reenlist on board the same ship. The only solution in sight is the six-year enlistment. This would add greatly to the stability of the ship's organization. We can get good recruits for a six-year enlistment, although perhaps it may be advisable to make an upward revision of the pay schedule. The importance of this step cannot be overestimated and it should be pressed home.

As to Aviation.—Aviation is as yet a virgin field which presents great possibilities. This subject, therefore, is one which lends itself to our imaginations and for this reason we should be careful in approaching it lest we be swept into the realm of dreams. Since the airplane was put into use there has been a tremendous development in all branches of aircraft, and it is still going on—perhaps even at an accelerated pace. We know that during the war the science of the air made notable advances, due to the pressure of war necessity and the unlimited funds which were available. But, if we review the progress which has been made in this branch since the Armistice, we may readily decide that the peace-time development has outstripped that made during the war. Airplane engines, for instance, have made notable advances over the Liberty engine which was the equal of any in the world of comparable power in 1917-18. The fundamental requirement of the war period was great production, and therefore types were held at a minimum.

In general we may say that the sphere of naval aircraft during the World War was extremely limited. Naval airplanes were used primarily for anti-submarine work, detached raids and scouting expeditions. Airships showed to greatest value to the Allies in convoy work, but for the Germans they excelled in their reconnaissance, scouting with the fleet, and bombing raids. The Germans had reached a far higher development of the airship than the Allies and had rather clearly divined its ultimate destiny.

The Armistice halted the development of aircraft, and in particular airplanes, toward an emergency purpose. It was recognized that aircraft were to fill a definite rôle in the great scheme of naval warfare and the development took a new turn with that in view. The development of types, and in particular the development of types suitable for use with the fleet, resulted; and this, together with the coordination of their use to the fleet, we may say was the *raison d'etre* of the Bureau of Aeronautics. We have developed rigid and non-rigid airships and the following types of airplanes: fighters, bombers, torpedo planes, scouting planes, observation planes and patrol planes. These are the fundamental functions which naval aircraft have to perform and it seems unlikely that there will be additional types in the near future, although of course there will be modifications of the present ones. On the other hand, the consolidation of types has already begun and it is readily apparent why the number of types with the fleet should be kept to a minimum, provided the necessary functions can be covered. One of the fundamental characteristics of a torpedo and bombing plane and of a scouting plane is their ability to carry a large, useful load and therefore, for use with the fleet, these functions have been combined in one general type.

What is the present performance of the airplane and what is its status? Airplanes have attained a maximum speed of about 265 miles per hour, a ceiling of about 39,000 feet, and a non-stop flight of about 3,000 miles. A land plane has been developed to carry two and one-half tons of bombs; another twenty-five infantrymen. These are records and do not give us a tangible footing on which to base their probable average performance in time of battle and under battle conditions. In general, we may say that a fighter has a maximum speed of 160 knots, a ceiling of 20,000 feet, and a cruising radius of about 450 miles. A scouting plane has a speed of about 105 knots and a cruising radius of about 1,000 miles. A torpedo and bombing plane can carry a torpedo or bomb of 1,500 pounds at a maximum speed of 105 knots, and has a cruising radius of about 500 miles. Such a plane carrying a torpedo cannot be launched from a catapult or from an aircraft carrier. A bomber may be launched from the deck of a carrier with a maximum weight of bombs of 300 pounds and, if launched from a catapult, with about 150 pounds of bombs.

The modern rigid airship has a maximum speed of 65 knots, a cruising radius of 4,000 miles at 40 knots and a useful load of thirty-five tons. It should be remembered that the given speed of aircraft is the air speed. We have reached the stage in airplane development where it is impracticable materially to increase the size of the plane in order to increase the useful load. It is well known that the larger the airplane the greater is the disproportion between the structural weight and the useful load. We have what appears to be a vicious circle; when the size is increased the heavy stresses when alighting are increased, and therefore the structural weight must again be increased. Hence we should not expect any marked increase in the cruising radii and the useful load carried by airplanes. Of course we may expect continued development in motors, propellers, structural methods, and so forth, and therefore gradual improvement. The opposite holds in the case of airships, where an increase in size increases relatively the useful load. This apparently holds good no matter how great the size may become, because if the airship is increased proportionately in all its dimensions, the volume increases as the cube but the surface as the square. Therefore less power is required relatively to the speed. Recently Great Britain has commenced construction of two airships of 5,000,000 cubic feet for use on its route to India. This is over twice as large as our *Los Angeles*. What is the limit? Formerly the limit was the size which could be handled by the ground force but since the development of the mooring mast it is recognized that the mooring factor as yet is no fundamental deterrent on increasing the size, although it also has its limits. Since a large useful load at a high speed is the fundamental argument, we look forward to a considerable increase in the size of airships.

The Navy, after much study and investigation, has decided that the air service is a powerful auxiliary for the fleet but that the battleships still represent the backbone of naval power. We believe that the three planes of naval activity—on the water, above the water, and below the water—are interdependent, supplementary, and cannot exist apart. Most of us face the future with open minds, but as things stand at present and in the visible future we are loath to scrap the power which has for so long been the deciding measure on the sea and which was the essence of the

Allied sea power in the war so recently concluded. But just as surely as we have been forming this opinion, public opinion has formed the exact opposite. The people of this country believe that the battleship is as doomed as the armored knight was of old, and that the virile airplane with its bombs, torpedoes and poison gas, and the submarine are now the all-important factors. It is a peculiar enigma that the American people will look to their engineers for their bridge and road work, to their doctors for medical advice, to their lawyers for legal advice, but when it comes to the Navy it seems to be taken for granted that technical knowledge may be dispensed with.

If we do not take steps to see that public opinion of the United States is guided by enlightened service opinion, we may undoubtedly expect the people so to influence congressional legislation that our military efforts will result in a series of crazes and spasmodic efforts, similar to those of France in recent years.

We have reached a stage in airplane development where we may say that in the near future there will be few fundamental changes. We may, however, confidently look forward to a gradual improvement in radius of action, speed, reliability and all-round efficiency.

New types will be evolved from time to time as may be necessary. Recently the Navy has developed, built and tested a small plane which can be carried on board a submarine. This is the *X S-1*, a small biplane with a twenty-one foot wing spread, weight 1,000 pounds and equipped with a sixty h.p. air-cooled motor. It can be knocked down and stowed in a four-foot hold within about five minutes and as readily assembled. Plans are also under discussion to carry one or more planes on destroyers but as yet no definite steps have been taken. It is likely, however, that eventually a catapult will be installed on destroyers at or near the stern for the launching of such aircraft.

We are realizing more and more the important advantage of having reliable engines in our naval aircraft. It will permit our aircraft to become, in fact, fleet aircraft by extending their operations at sea. It will reduce losses, increase the morale of our pilots, and reduce the number of carriers and tenders required. The present trend seems to be toward single high-powered engines with a probable future development of a standard three unit power plant—any two of which can support the plane in flight. High

speed, ceiling and other advantages should, if necessary, be sacrificed for reliability.

A most important feature for a naval airplane is its useful load. If the airplane is to wrest the supremacy from the battleship it must first of all be able to carry bombs and torpedoes sufficient in size and number to sink them. The useful load of a bomber is therefore a first consideration. The amount of useful load depends upon the available horsepower in excess of that required to lift the airplane itself. Hence the importance of increasing the power output. There are only about thirteen engines, of 600 or more horsepower, that have actually been completed; of these seven are of French design, three British, two American and one Italian.

Of recent years the building of water-cooled engines is gradually being discontinued and in their place has been developed the direct air-cooled engine. Today practically all engines of less than 300 horsepower are of the latter type. This is a step of great importance since the water-cooling system is in excess of twenty-five per cent of the weight of the engine itself.

Heavy oil engines operated on Diesel principles for aircraft have been experimented with in several countries and it is claimed that a satisfactory type has been developed. Apparently they are of the direct injection type and operate without carburetor and spark plugs. The fuel is ignited by subjecting it to the required pressure. The fundamental advantages are the safety from fire, and fuel economy, which not only means the economy resulting from a cheaper fuel than gasoline but also, it is claimed, a decreased weight of fuel consumed per horsepower hour. The chief disadvantages are the greater initial weight of the plant and perhaps also a reduced flexibility of control.

The disadvantages which an airplane incurs in forewarning the enemy of its approach by reason of the noise and in increasing the difficulties of communication have long been recognized and efforts have been directed to overcome them. The well-known drone of airplanes is caused primarily by the exhaust gas leaving the engine and secondarily by the whirr of the propeller. Perhaps the most efficient silencer yet produced is the Swiss "Ad Astra" type, which, it is claimed, reduces the exhaust noise about seventy-five per cent. The use of geared propellers has also been found to work to advantage in this connection.

Aircraft communication has been receiving more and more attention lately but even so we may say that it is still in its infancy. Some developments that have been made of late have increased the reliability and general efficiency of aircraft communication to no small extent. An emergency transmitting apparatus has been developed for multi-motored planes which enables them to send radio messages when the plane has been forced to land on the water. The radio generator is run by one of the good motors. The problem of providing planes with suitable antennæ has been a difficult one. It was formerly the practice to use a trailing antenna while in the air. This was wound on a reel when not in use and before landing and, obviously, provided no antenna when the plane was forced to land on the water. Some planes were provided with an antenna rigged to the upper wing—a skid-fin antenna. This provided communication irrespective of whether the plane was in the air or on the water but the range was small—about ten or fifteen miles. A kite has been developed which carries the antenna when the plane is on the water. At present, airplanes are capable of communicating over distances of about 400 miles with ships and shore stations and about 150 miles between planes. Aircraft communication, especially that between planes, is not reliable at the present time and this is an urgently needed line of development for the future. Airship communication is considerably in advance of that of airplanes, as was demonstrated by the *Shenandoah* on her transcontinental flight. She maintained reliable communication at all times, although in many instances she worked through amateur operators.

Progress in the all-metal construction of airplanes has been slow. Numerous countries have been carrying on development work in this direction and successful tests have been reported. High cost and various problems incidental thereto have been militating against general adoption of this type. Steel, aluminum and duralumin have been experimented with, the latter apparently combining greatest strength and elasticity with least weight, but also, it must be said, greatest cost. The benefits to be derived from the use of all-metal construction in decreasing the vulnerability of the airplane, reducing the fire hazard, and decreasing the soakage weight of seaplanes are obvious. In connection with the latter it was found that an *F-5-L* plane had gained 1,500 pounds weight

from soakage after operating for several months with the aircraft squadrons. For rigid airships it is probable that an aluminum sheeting will be developed and used for the outer covering in future construction, primarily for its greater durability.

Although inventors have been working for years to develop a satisfactory helicopter and zest has been added to this development by the prize of £50,000 which the British Government has offered for a helicopter which will meet certain specifications, little progress has been made and at the present time, so far as is known, there is no helicopter in existence which can approach the British requirements. However, the advantages of this type are so great that its development should be continued. It would be an ideal machine for fire control and observation, and, in general, would have the combined advantages of the plane, the dirigible and the stationary balloon with practically none of the disadvantages. It could rise from the deck of a ship without the need for a flying deck or catapult and soar over any desired point or over the ship whose fire it is observing, or, when required, translate its motion into horizontal movement. It might even be able to return to the ship from which it took off; a feat which is now impossible except on aircraft carriers fitted with a flying-on deck. No radical improvement may be expected in this type, but there are hopes for the future.

The idea of a carrier airship is fundamentally sound, as was proven by the experiments completed by the Army last year at Mitchell Field, Mineola, Long Island, when airplanes were picked up and released in flight by an airship. The problem of releasing and taking on the planes offered no serious difficulties. There is one very important problem which must be solved before the airship can become a carrier of airplanes and that is the question of ballast. With a seagoing aircraft carrier, such as the *Langley*, the release and taking aboard of airplanes offers no problem at all so far as weight and ballast are concerned; but with the airship the release of a plane means an increase in altitude and conversely the taking on of a plane, a decrease in altitude. The release of a plane can at present be compensated by valving, but this precludes the possibility of taking the planes on again and, in the case of helium, means the loss of a precious gas. This difficulty may perhaps be overcome by generating gas on board. Then, too, perhaps,

in the future it will not be necessary for the airship to take the planes aboard except for short intervals when in need of fuel, repairs, a relief pilot, and so forth. This would help solve the ballast problem and also would enable the airship to serve a great many more planes. The carrier airship combines the advantages of the long cruising radius and reliability of the airship with the speed and punch of the airplanes. It will be invaluable in the execution of many tactical and search problems, although the sea-going aircraft carrier is unquestionably more efficient and economical under ordinary circumstances.

At the Battle of Jutland we find the first instance in history of an aircraft carrier operating with a fleet in a modern naval battle. This was H.M.S. *Engadine*. She was, of course, an improvised carrier and launched the planes by putting them over the side with the crane. The British were not only first in this field but they have also done more development work along this line than any other nation. They have two big aircraft carriers, the *Eagle*, an ex-battleship, of 22,790 tons, and the *Furious*, an ex-battle cruiser, of 19,100 tons; and two carriers of moderate size, the *Argus* of 14,450 tons, and the *Hermes* of 10,950 tons. The *Hermes* is the first ship especially designed as an aircraft carrier. The *Eagle* and the *Furious* have not proved very successful but the *Argus* has given good results in actual practice and is, perhaps, the most successful of them all. Japan has one converted carrier of moderate size and is building two others of large proportions. The United States has the converted *Langley*, of 12,700 tons, and is building two others of 33,000 tons. The treaty of limitation of naval armaments has limited the size of future aircraft carriers to 27,000 tons with the exception of several, originally laid down as battle cruisers. We are limited by the same treaty to a total tonnage of 135,000 in this type, exclusive of the *Langley*, which is classed as an experimental type. This leaves, therefore, 69,000 tons of this type that we may build. How may we utilize this tonnage to best advantage? In 1926 the *Lexington* and the *Saratoga* are due to be commissioned and the solution of many problems will depend on the experiments to be conducted with them. If we wish to add to our Navy 69,000 tons of aircraft carrier, as indeed we should, we have to decide whether we should build a few large ships of this type or a greater number of smaller size.

Judging by the ships building at the present time one would be led to believe that the experts of the naval powers are decidedly in favor of aircraft carriers of large dimensions. This is perhaps true but the main reason why, is that the United States and Japan had large battle cruisers building which, by the terms of the naval limitations treaty, were permitted to be converted. The hue and cry of "too many eggs in one basket" has again been raised but as in the case of battleships this argument may be overruled by other considerations.

Perhaps the most important question in this connection, however, is what types and how many of each is the ship to carry. This question is, fortunately, not one which demands immediate and accurate solution since the planes are not built into the ship as are guns on battleships. However, we should study this problem carefully and lay our plans accordingly.

There is no one answer to it. It is readily apparent that the composition of our planes must vary with changing conditions. In one case we might need a preponderance of fighters, or, under other circumstances, bombers. With the fleet we must take what we have in preparing for battle but with our aircraft we are certain of having a selection. The advantage of looking ahead and studying future requirements cannot be overestimated.

Many years ago men watched birds in flight and when aviation was in its infancy attempted in their experiments to imitate the movements. It has long been a source of interest and wonder to watch birds remaining in the air for protracted periods and even actually gaining altitude without any apparent motion of their wings. We know now that the birds utilize the force of the wind in doing this. The glider existed before the airplane but its progress has not been so great and certainly not so spectacular. In recent years the glider has been receiving more attention than ever. Germany, forbidden by the terms of the Versailles Treaty to continue aviation development, has undertaken extensive glider experiments, and France, not to be outdone, has done the same. In these experiments gliders have been maintained in the air for hours at a time and have actually equalled the feat of the birds and have gained altitude. This, of course, was accomplished without any motive power and simply utilizing the force of the wind. On January 3, 1923, Lieutenant Thoret, a French military aviator,

established what is believed to be the world's record to date when he succeeded in keeping his glider in the air for seven hours and three minutes at Biskra, Algeria. The glider has no engine and is therefore considerably lighter than an airplane, but otherwise it is not essentially different; also, glider experiments have been successfully made when using regulation army planes. Perhaps it will be some time before we can utilize this glider experience in our aviation work but eventually, no doubt, it will be combined. Airplanes in fire control, observation and patrol work will use their motors only occasionally and during the remainder of the time soar over their station. This would be of great advantage in fire control observations and in communications. It would also increase the plane's cruising radius and its ability to stay out for longer periods.

Various foreign countries, as well as the United States, have developed successful pilotless airplanes, controlled by wireless from the ground. These planes are made to take off, level off at a certain altitude, circle over a desired point, and then descend safely to the ground. This is a marvelous development and speculation has been rife in our newspapers as to its effects. Some writers seem to think that it portends a war of combats between crewless planes, bombardment of distant cities by crewless airplanes, and, in general, the declining usefulness of the aviator in war. However, this is a situation not founded on present or prospective development. In order for the crewless airplane to be under wireless control it must be in sight of the operator on the ground. Bombing with accuracy is difficult enough for the aviator who is in the bombing plane; how much more so must it be when the plane is distantly controlled. What chance would these planes have against an intrepid aviator in a fighting plane? Would they, in fact, be able to defend themselves? It is, however, not hard to imagine special situations in which the use of pilotless airplanes would be advantageous and this much should also be said for them: they can be used without risking human lives. This, however, should be mentioned guardedly, knowing as we do that history teaches us the disastrous effects of trying to dodge risks in war.

The wireless transmission of power has been successfully demonstrated experimentally, and a British inventor, H. Grindell-

Matthews, has established beyond question the practicability of paralyzing an internal combustion engine fitted with electrical ignition. This has opened up another field for development and one which may have a pronounced effect on naval warfare. In the future it may be necessary to provide some other motive power for airplanes and the eventual engine may be an electric motor to which power is transmitted by wireless from stations on the ground.

The air force has, in the past years, continued to supplement the functions of the fleet and in the future may wholly take over some of these functions. It is not difficult to visualize their undertaking additional functions, such as the transportation of small expeditionary forces to enemy countries or the succoring of beleaguered garrisons.

As to Material in General.—Unlike the airplane, the submarine has not gained materially in power since the war, and the prospects for the future are not very promising, due to the fact that it has certain definite and ineradicable weaknesses. It has a comparatively low submerged speed and it will always be relatively vulnerable to counter-attack. The submarine costs about twice as much per ton to build as a battleship and about four times as much to maintain in commission, ton for ton. The submarine, both submerged and on the surface, requires a considerably greater horsepower for the same speed per ton displacement than the battleship or the destroyer. In fighting power per ton, the submarine is far behind surface craft. The quality of submergence makes this type necessary and important, but this can only be obtained by a very heavy sacrifice in the other factors.

Before the development of the depth charge and anti-submarine tactics of the World War, the submarine's defense against its enemies at sea was positive and absolute. It took years of war before the Allies had learned to take full advantage of the submarine's limitations. The submarine will always be dangerous and formidable, especially as a commerce-destroyer, but as a menace to the capital ship it is less to be feared today than prior to the World War.

The United States Navy is at present sorely in need of submarines which have the speed, sea-going qualities, and other characteristics necessary to operate with the fleet and which have been

so trained. In the next war a submarine force will undoubtedly operate with the fleet in battle, and to this end they must be trained, indoctrinated and coordinated with the other fleet units in time of peace. The submarine mine layer should be developed since it seems to be a type which will be of considerable use in fleet tactics.

Professor O. Flamm, a noted German naval architect and submarine expert, has designed a very interesting super-submarine of 7,067 tons surface displacement. To appreciate what a step this is into the unknown, it need only be said that the largest submarine which has been built to date is the British *X-1* of 2,780 tons surface displacement. It is to carry five-inch armor on conning tower and upper works, two 8.2-inch guns, four 3.4-inch guns, and ten torpedo tubes. It is to have a surface speed of 22.5 knots and a cruising radius of 23,000 miles. He has also designed a mine-laying submarine on the same order which would carry 1,000 mines. Granting that he has solved the problem of stabilizing such a large submarine as this is, it has at present no clearly defined rôle in naval warfare, and its usefulness, considering the tremendous cost, would be extremely doubtful.

The future of the battleship has been discussed to a certain extent as to the effects of the Washington Conference. There are also several lines along which the battleship seems destined to develop which are more or less independent of the effects of the treaty limiting naval armaments. The problem of properly protecting battleships against aircraft has not yet been solved. The anti-aircraft battery requires improvement in numbers, design, location, operation and control. Bombs and high-angle fire render imperative a greater protection to the upper works and the vitals of the ship. Since the caliber of guns is now limited to sixteen inches, development undoubtedly will tend toward greater muzzle velocities. The improvement of fire control instruments and methods toward simplicity and flexibility of operation is under consideration. The part which gas will play in the next naval battle is a matter of speculation. The gases which may be used are well known and it is doubtful whether much progress has been made since the Armistice toward discovering new and more dangerous gases. We do know that gases for war purposes are being made in volume by all of the powers. The problem which the Navy has to solve is to bring these gases in quantity to the scene

of the naval battle. Gas is a factor which must be considered in the next naval battle, and from the point of view of the battleship, protection against these gases must be provided.

On our latest battleships, the *Maryland, Colorado* and *West Virginia,* there are installed Diesel engines which drive the electric generators for general port use. No steam is required except for the main engines. This accounts for the small fuel consumption of these ships in port and the resulting gain in economy is about one third. This is an indication of what may be expected. The Diesel engine and the modifications of Diesel electric, etc., will herald a new epoch in naval engineering—greater, indeed, than when the turbine superseded the reciprocating engine. Some of the important advantages of the Diesel engine over steam machinery for naval vessels are (1) greater radius of action per ton of fuel; (2) economy of operation; (3) ship can get under way quicker; (4) risk of serious damage to machinery in battle greatly reduced due to absence of boilers and steam pipes: (5) absence of uptakes and funnels would reduce vulnerability to attack from bombs and high-angle fire, increase efficiency of armament, reduce deck-hamper, which is important for aircraft carrier, reduce visibility at night due to absence of sparks and flames (this is especially important in evading aircraft), and reduce visibility during daylight, due to absence of smoke; (6) full power can be reached from cruising speed in shorter time. As a seventh advantage the writer would list the absence of condensers, since it has been his misfortune to have considerable trouble in this connection. It has, however, general application and we have only to recall how greatly the British fleet was handicapped, especially during the early months of the war, due to this same trouble.

So great, indeed, are the advantages of the Diesel engine, that we must have it and once we make up our mind to that effect we will have it. The great difficulty which has been met in the Diesel engine is the low power capacity of the individual cylinder and until this is considerably increased it cannot replace steam machinery on our capital ships. With this end in view the Navy has been conducting extensive research work in scavenging, supercharging air compressors, mechanical fuel injection and similar lines. No Diesel engine of really large power has been produced and successfully operated to date. A prominent marine engineer,

however, predicts that in the near future battleships will be equipped with Diesel engines generating 10,000 b.h.p. on each of four shafts. Eight cylinders would drive each shaft. Each cylinder, therefore, would have to generate 1,250 b.h.p. Cylinders of that power have been produced experimentally. The 40,000 b.h.p. which such a plant would develop would be sufficient to drive a 35,000 ton ship at about 23 knots.

The radio is of vital importance to the Navy and yet under certain circumstances in time of war it may be impracticable to use it. In the late war, both the British and the Germans report that they were able to locate and identify enemy ships by their radio and in numerous cases were even able to tell what operator was sending the message. We now are forced to maintain radio silence when expecting contact with the enemy fleet, when approaching the enemy coast, and in other similar situations. Successful experiments have been made in directive radiation which will cause most of the waves radiated from a radio transmitter to follow a particular path rather than to spread broadcast, as at present. This will be of valuable assistance in time of war. Wireless telephony is at present a short range means of communication. Recent developments, however, have shown that long distance transmission is possible.

Ever since about 1910 gyro stabilizers for ships have been experimented with and these are still in progress. The development has been slow and numerous reverses have been suffered. The advantages of such a stabilizer for a naval vessel may be summarized as follows: (1) Improved gun platform. (2) Improved landing platform for aircraft carriers and other ships with flying deck. (3) Guns would be less hampered by spray in heavy weather. (4) Improved living conditions and comfort—this is an item of importance on transports and hospital ships. The speed per unit of power would also be increased as well as the accuracy of steering and both of these mean increased cruising radius but this would probably be counterbalanced by the power required to run the stabilizer. The stabilizers which have been experimented with were designed to eliminate rolling only. No really successful ship stabilizer has been developed to date, but its advantages are such that development work along this line should be continued.

An important factor in the modern naval battle is the stability

control of battleships and it is one which the United States Navy has only barely touched. The Germans had made great strides in this study and on several battleships during the Battle of Jutland it was used to good advantage. By stability control is meant the art of giving, reducing and controlling the lists of a ship by the flooding of certain compartments. It may be utilized to give the main battery guns a greater range, by increasing the angle of elevation, than would normally be possible. In time of battle when a battleship is closely engaged it is a considerable detriment to have a list. The ship and its appliances are designed and built to operate on a normal keel. A list makes the guns hard to load and difficult to handle. It may expose a portion of the hull unprotected by armor. It may reduce the efficiency of the director system. It changes the angles of elevation of all guns on the ship. This is bound to reduce their efficiency and may prevent certain guns from being brought to bear. Boilers, bearings and other machinery are designed for operation on normal keel. With a list, machinery derangement is apt to occur, and, in the case of boilers, portions of the heating surfaces may be uncovered. In time of battle there should be one officer solely charged with the stability control of the ship. He should have adequate training and frequent opportunities for experimentation in time of peace.

It is interesting to compare maximum effective gunnery ranges which have been used in actual battle since Nelson's day. At the Battle of Trafalgar in 1805 it was but 300 yards; at the Battle of Santiago, ninety-three years later, it was only 2,000 yards; at the Battle of Tsushima in 1905 it had increased to 9,000 yards, and at the Battle of Jutland in 1915 it was no less than 18,000 yards. The above figures are, of course, open to dispute, since it is a question in each case at what point the maximum effective range commenced, but they are approximately and relatively correct. The striking point in comparing the above figures is the great advance which has been made in gunnery ranges since the Spanish-American War. That this progress is still going on is apparent from the results of recent target practices and today the maximum effective range is well over 20,000 yards. Gunnery ranges have been limited by the visibility. Since the Armistice, extensive experiments have been conducted in the observation of gunfire by aircraft but the problem has not yet been definitely solved and main reliance must

remain on observation from the fighting tops of the ships themselves. Eventually, it is certain that primary control of the observation of fire will pass to aircraft but there remain two fundamental problems which must be solved first. It is essential to devise for fleet engagements a reliable means of designating to the aircraft the target at which the ship is firing and reliable communication between ship and plane must be ensured. When that has been accomplished there is no reason why considerably greater ranges should not be attained. The present tendency is to develop higher velocities rather than to increase the weight of the guns. The Germans at Jutland showed what could be done with comparatively light, high-velocity guns, fired with rapidity and ably controlled. Fire-control must be made more flexible, so that commanders of battleship divisions will be free to develop battle tactics without having to give irksome consideration to its effect on gun fire.

Our present system of gunnery development is such that progress is not assured. We experience a periodical change of gunnery officers in the fleet and with each new régimé we experience a change in gunnery theory and practice. Gunnery theory, in particular, must be stabilized, standardized and developed throughout the service. To do this, we must have a gunnery school. This would insure unity and direction in gunnery development. By staggering the detachment of the officers on the staff of such a school, a permanent nucleus would be left to carry on the work uninterruptedly.

The great disadvantage of the compressed air torpedo, as noted during the World War, was the fact that it left a wake. Observers on the ships were able to follow these wakes and, by maneuvering, were able to dodge them. The Germans undertook the development during the war of a trackless torpedo in order to meet the needs of the submarine service. This torpedo consists essentially of a storage battery which furnishes the necessary power for driving electric propulsion motors. The size of this torpedo was approximately twenty-one inches. It had a maximum effective range of 1,650 yards and a speed of 25 to 27 knots. Various countries have since been experimenting with the electric torpedo and it is understood that reliable torpedoes have been produced which have a maximum effective range of about 5,000 yards. A

German manufacturer claims that he can turn out a twenty-five-inch electric torpedo with a range of 10,000 yards. The advantages of the electric torpedo are so manifest that its development should be pushed to bring it to a high state of performance. The wireless control of torpedoes after they have been launched has received considerable attention during recent years and the successful experiments which have been conducted would lead one to believe that the practical application of this invention is entirely feasible. This will permit of the changing of direction of torpedoes after they have been launched and thus, to a great extent, it would nullify the possibility that the enemy will be able to avoid torpedoes by maneuvering.

Conclusion.—Never before in all history have navies been confronted with such a complex problem as at the present time. The last great fleet engagement, the Battle of Jutland, was fought by surface ships entirely. The next great naval battle will be fought not only upon the surface but also above the surface and below the surface. Not only must the doctrine and tactics of each type be developed, but the interrelation of the different types must be determined. The naval forces on three planes must be indoctrinated and coordinated to work toward the common end—victory in the next fleet engagement.

LESSONS OF JUTLAND AFFECTING DESIGN OF TURRET ARMOR

By Lieutenant Neil B. Musser (CC), U.S.N.

THE battle started when the *Lion* opened fire at 3:48 P. M. on May 31, 1916. Five minutes later, after only eleven rounds had been fired, a direct hit on the turret proper temporarily knocked out the *Tiger's* X turret, and another heavy shell struck the front roof plate of her Q turret at the edge of the center sight port, and burst on top of the turret without penetration. The sight port was blown off, fragments destroyed the officer's hood, the range finder and periscope, and pieces of roof armor which were blown inward killed two men, wounded one mortally, and did considerable damage to the material in the turret. Both loading cages were damaged, and one could not be repaired during the battle. The electric firing circuits were carried away. From photograph, reference (b), the roof appears to be about two inches thick. This turret continued to fire, although at reduced efficiency.

Four minutes later the *Lion's Q* turret was hit by a 11-inch or 12-inch shell which struck the joint between the sloping armor face plate and the roof of the turret over the center line of the left gun, at a point just abaft the trunnions. The shell exploded in the turret and put both guns out of action. Everyone in the turret proper and practically everyone in the control booth and the pan were killed outright. The ship was saved from the fate which later befell the *Indefatigable, Queen Mary* and *Invincible* by the cool headedness of the badly wounded turret officer who immediately ordered the magazine doors to be closed and the flood valves to be opened. This officer also sent his wounded sergeant to the

References: (a) *Modern History of Warships* and *Protection Notes, M. I. T.*, Hovgaard.
(b) *The Fighting at Jutland*, Fawcett and Hooper.
(c) *The Battle of Jutland*, Bellairs.
(d) *The Grand Fleet*, Jellicoe.
(e) *Kiel and Jutland*, Von Hase.
(f) *Jane's Fighting Ships, 1915.*
(g) *Jane's Fighting Ships, 1922.*
(h) *Germany's High Seas Fleet*, Von Scheer.

A. TABLE OF MISCELLANEOUS DATA ON SHIPS
BATTLESHIPS

Name	Date	Displacement	Speed	Guns	Armor			Type Ship	Navy
					Belt	Turrets	Barbette		
**Malaya* and **Warspite*	1913–1915	27,500	25	8–15″	13″ max.	11″ max.	10″–7″	*Queen Elizabeth*	British
Royal Sovereign	Begun 1915	29,400	22	8–15″	13″ max.	13″–5″ 5″ roof	10″–7″	*Royal Sovereign*	British
Mutsu	1919–1924	33,800	23½	8–16″	12″ or 13″ max.	14″ max	.....	*Mutsu*	Japanese
Colorado	1920–1924	32,600	21	8–16″	16″–14″	18″–9″ 5″ roof	13″ max.	*Colorado*	U. S.
BATTLE CRUISERS									
**Invincible*	1907	17,250	26½	8–12″	7″ max.	7″ max.	8″ max.	*Invincible*	British
**Indefatigable* & **New Zealand*	1909–1911	.....	26½	8–12″	8″ max.	7″ max.	8″ max.	Somewhat enlarged *Invincible*	British
**Lion* and **Princess Royal*	1910–1912	26,350	28	8–13½″	9″ max.	9″ max.	9″–8″	*Lion*	British
**Queen Mary* (See note 2)	1910–1912	.....	28	8–13½″	9″ max.	9″ max.	9″–8″	Somewhat enlarged *Lion*	British
**Tiger*	1912–1914	28,500	28	8–13½″	9″ max.	9″ max.	9″–8″	*Tiger*	British
**Seydlitz*	1912	25,000	26½	10–11″	Prob. 11″ max.	8″ max.	10½″ max.	*Seydlitz*	German
**Derfflinger* and **Lutzow* (see note 3)	1913	26,600	26½	8–12″	Prob. 13″ max.	No information		*Derfflinger*	German
Hood (note 4)	1916–1920	41,200	31	8–15″	12″ max.	15″ Face 12″–11″ sides, 5″ roof	12″ max.	*Hood*	British

NOTES: (1) Ships marked (*) took part in Battle of Jutland. All other ships completed after Battle of Jutland.
(2) Barbettes *Queen Mary* only three inches thick below one inch upper deck and one inch below two inch maindeck.
(3) According to reference (f), *Derfflinger* had four inch flat deck amidships over three inch sloping armor, for protection against aircraft, and of course against high angle fire.
(4) Reference (g) states *Hood* was "re-designed to meet lessons of Jutland. Outstanding features are huge area covered by heavy armor and strong framing. In fact, general scheme of protection is on lines of German Battle Cruisers."
(5) In British ships Nos. 1 and 2 turrets forward of stacks are lettered "A" and "B" respectively. Nos. 3 and 4 turrets or the last two aft of stacks are lettered "X" and "Y" respectively. When there are two midship turrets which are in echelon, as on *Invincible*, the turrets are lettered "A", "B", "X", and "Y" from forward to aft, as in above case. When there is a turret forward of the after stack, as on *Lion*, such a turret is lettered "Q".
(6) In German ships Nos. 1, 2, 3 and 4 turrets are called Anna, Bertha, Caesar and Dora, respectively.

N. B. M.

bridge to report the damage to the captain. This man and only two others in the whole turret crew escaped alive. The explosion had thrown back the breech operating lever of one of the loaded guns and unseated the projectile, which in turn pushed out the cordite powder bags into the gun well. The first explosion had ignited some debris in the turret, and this fire ignited the cordite charge, which caused a terrific explosion to occur. The flame and gases vented themselves through the hole in the roof through which the shell had entered, and the flame shot about 200 feet high. From the photograph given in reference (b), the roof armor on the *Lion's* turret appears between two inches and three inches thick. About sixty deaths occurred, including the casualties caused by the first explosion. The effect of the cordite fire, when noted afterwards, was peculiar. Most of the men killed by the cordite fire were not burned and the parts of their bodies which were protected from the fire by non-inflammable material were not even discolored. It seems that the pressure was chiefly responsible for the almost instantaneous deaths which occurred. By way of digression, it might be noted that the *Lion's* cordite fire resembled very distinctly the recent occurrence on our *Mississippi,* where a number of naked powder bags were ignited in the turret, about forty-five men were killed outright, and the ship was saved from blowing up by the quick action in closing and flooding the magazines. In this case, also, men were killed by pressure and gases who were not apparently touched by the direct flame or even the heat of the explosion. No evidence of smoke or flame could be detected along the path of gas outside the turret proper.

About sixteen minutes after the beginning of the action, the *Indefatigable* was hit by several projectiles of the same salvo at a point about on a level with the upper deck abreast the after turret. The magazines exploded immediately and the ship sank soon after. Another account, contained in reference (a), states that a shell also hit the forward turret and that the ship then completely blew up, the explosion starting with sheets of flame followed by dense smoke. The ship then quickly capsized and sank. To illustrate the force of the explosion, it is noted that the fifty-foot picket boat was blown intact to a height of approximately 200 feet. It is probable that one or even two magazines were exploded by shells

which pierced the turrets proper, the barbettes, or the protective decks in way of magazines.

In the early part of the action a heavy shell hit X turret on the *New Zealand* but it did not penetrate. The turret officer at first thought he was dead but soon found his error and continued to "carry on." At about 4:26, or thirty-eight minutes after the beginning of the action, the *Queen Mary* blew up. A terrific crimson flame shot up through a great cloud of smoke to a height of approximately 800 feet. The stern rose high in the air with the propellers racing, and the whole ship disappeared immediately after. Eye witnesses say that the turret roofs were blown 100 feet into the air. Soon after the *Queen Mary* sank, a salvo hit the *Princess Royal* abreast her Q turret, but did no serious damage.

A heavy shell penetrated the side armor and burst in the ammunition passageway on the *Tiger*. The base of this shell punched a hole through the bracket which held the main steam pipe at the forward bulkhead of the port engine room. Had this fragment hit the steam pipe, the ship would have been disabled in a critical part of the action, and would no doubt have been quickly destroyed. The explosion of this shell killed a dozen men, set off the ready cordite powder in the passageway, severed fresh and salt water mains and high pressure air main, and made it necessary to flood the midship six-inch magazines.

About 5:20 P. M. during the run north, the British battleship *Malaya* was hit abreast a turret below the water line. One ammunition hoist cage was jammed and five rounds had to be loaded by hand, but no serious damage was done. Just before 5:30 P. M., a 12-inch shell punched a clean hole through the six-inch side armor in way of boys' mess deck on the *Warspite,* and hit X barbette but did not penetrate. This shell was later found on board unexploded. Another 12-inch shell came on board and exploded down through the mess deck. Soon after, a large corner was blown off one section of the thirteen-inch main belt.

About 6:33, or two hours and forty-five minutes after the beginning of the action, when the range had decreased to about 8,000 yards, the *Invincible* was badly hit, blew up and broke in two. It is believed that one or more shells penetrated a turret, possibly through the roof, and exploded inside, setting off the midship

magazine. A crimson flame rose about 400 feet high and carried with it a huge bulk of plating. The hull, thus weakened amidships but possessing approximately its original buoyancy at the ends, broke in two. The bow and stern were left projecting above water, bottom side up.

During the third phase of the battle (about 5:50 to 7:05 P. M.) when Beatty carried out his outflanking movement and placed himself ahead of the main British fleet which was then entering the battle, and during which period the *Invincible* was lost, the *Derfflinger* was hit repeatedly by heavy shells fired at her by several battleships at a time at comparatively short ranges, averaging about 10,000 yards. She left the line several times to escape from the fury of the falling shells. Two armor plates were torn away in the bow, leaving a gap in the side about seventeen by twenty feet just above the water line, but no vital damage to this remarkable ship was effected.

In the fourth phase of the battle, (7:05 to 7:37 P. M.) when von Scheer hurled his battle cruisers and destroyers against the semicircle of British battleships to cover the escape of the High Seas Fleet, which reference (e) calls the "death ride of the battle cruisers," the range quickly dropped from around 13,000 yards to 9,000, and a large number of hits were scored on the *Derfflinger*. About 7:13 a heavy shell pierced the armor of her Caesar turret and exploded inside, setting off all the exposed powder in the turret. Flames shot up "as high as a house," but the timely closing and flooding of the magazines saved the ship. Of seventy-eight men, only five, who dropped through the scuttle provided for ejecting the empty powder cases, escaped with their lives, though these were badly burned.

Soon after, a similar fate overtook Dora turret, where a major caliber shell pierced the roof and exploded inside. Then hit after hit shook the ship, and the British seemed to have the *Derfflinger's* range exactly. At this time the conning tower received a direct hit from a heavy shell which failed to pierce. It had probably struck at an unfavorable angle, but huge pieces were torn out and fragments which entered the navigating division of the tower wounded several men, including the navigator. None of the gunnery apparatus was disturbed, however, and even the delicate sighting

mechanisms were still in order. The rear door, which had been blown and jammed open by this shell, was soon shut by another, which burst below the tower and blew overboard all of the lighter part of the ship's structure in that locality. Only the timely signal to withdraw saved the battle cruisers from complete destruction.

The *Seydlitz* was hit by twenty-eight shells and a torpedo during the battle and it seemed almost impossible to sink her. At one time great flames were seen to issue from a turret, which had probably suffered the same fate as the *Derfflinger's* two after turrets. She remained in line until the end of the battle, and though she had to be beached some time afterwards to keep her from sinking, she was later refloated and repaired. It was this ship that was set on fire by a heavy high angle shell at Dogger Bank, which pierced the turret foundations and set off the exposed powder in the turret, causing some loss of life. According to reference (h), the first shell that hit the *Seydlitz* wrecked the officers' quarters, perforated barbette armor of turret No. 4, and ignited a charge. The fire spread to turret No. 3 and the entire gun crews of both turrets perished almost instantaneously.

The *Lützow* also stood very heavy punishment, and was repeatedly hit by heavy shells. About the time the *Invincible* went down, the *Lützow* was reported to the *Derfflinger* as badly hit forward, with a list and on fire. She was abandoned by her crew about 3:00 A. M., and sank soon after. The Germans claimed that they torpedoed her themselves.

Taking this question in its broadest sense, we must inquire into every case on record in which major caliber shells struck armor during the battle, since a certain proportion of all hits must be on the turrets, and, if we assume the same method of support to be used, turret armor behaves like any other of the same type and thickness when struck by the same size shell at the same angle and velocity of impact. In this study will be included some data on the Dogger Bank action, in which several of the same battle cruisers participated which later faced each other at Jutland. The part of the Battle of Jutland which is of most interest to us here is the preliminary fighting between Beatty's and Von Hipper's battle cruisers. During this phase of the action, the British lost the *Queen Mary* and *Indefatigable*, while no vital damage was inflicted

on any of the German ships. This part of the battle was fought at ranges varying from approximately 12,000 to 19,000 yards, the latter of which were in the same neighborhood as those used at Dogger Bank, where the extremely high angle of fall, estimated at 22°, was especially noticeable. The armored cruiser *Blücher* was destroyed primarily because these high angle shells pierced her decks and exploded below in bunkers, stoke holds and engine rooms. The *Queen Mary* and *Indefatigable* were probably destroyed by high angle shells which pierced the turret roofs or decks and barbettes and thereby succeeded in setting off the magazines. The ever increasing danger from attack from aircraft, together with danger from gun fire indicated above, makes it appear desirable to allot a larger portion of the available turret armor weight to the roof than was formerly considered necessary. This conclusion is also borne out by the experience on the *Lion*, where weakness in the turret roof armor in general, and a lack of strength at the joint between the roof and the sloping front plate in particular, all but caused the loss of that ship. Hovgaard recommends a five-inch to eight-inch roof, vaulted in the transverse plane, and sloping in the fore and aft plane from approximately horizontal in the rear of turret, to about 20° at the junction with the front plate. This declination can be reached by a continuous curvature or by two or more steps. Three and one-half-inch to five-inch deck armor is now used on modern battleships, due to the danger from high angle fire and aircraft. Nothing under a five-inch roof should, therefore, be considered for the turrets of battleships and battle cruisers.

The front plate should slant to reduce the port opening, and should be the heaviest plate on the ship, since it is badly weakened and is always facing the enemy. This plate should be at least equal in thickness to the belt, and in American ships is two inches greater. The experiences on the *Warspite* and *Lion* indicate that great care must be taken in the design of joints in the armor, since these are of necessity points of weakness. No unnecessary projecting parts which are liable to bring shells to explosion should be permitted. From this angle alone it appears that the practice of carrying fully exposed, but armored range finders on the turrets, as is followed on the *Hood*, is less desirable than to permit

only the ends of the range finders to project from the sides of the turrets, as is done on our ships.

With the exception of the major caliber hits on the *Derfflinger, Lion* and *Tiger,* no record is available of serious damage by gun fire to a turret proper. The great weakness seemed to exist in the barbettes and protective decks, or the protection to the turret foundations and magazines. In the Dogger Bank action, a major caliber shell pierced the foundation of a turret in the *Seydlitz* and set off some powder, but the fire failed to reach the magazines. Loss of the ship was here narrowly averted by the personnel after the armor protection had proved inadequate. The *Seydlitz* had an eleven-inch belt as opposed to an eight-inch in the *Indefatigable,* which indicates that the latter's armor was entirely too light. Throughout this discussion, belt thickness must be taken as a criterion of the extent to which a ship is protected by armor, since data on the thicknesses in many locations, such as bulkheads, decks and the various parts of the turrets and barbettes are not available. It is assumed that the thicknesses of the various parts of the armor protection are in proportion to the maximum thickness of the belt, these ratios being approximately the same for all ships. It can therefore be assumed that the *Warspite's* protective deck, which was entirely too light to withstand the explosion of a shell above it, was heavier than the deck armor on any of the battle cruisers, and that these latter ships were in general far too weakly protected.

Though it has been possible to bring a modern, heavy, high explosive projectile through modern plate of caliber thickness and have it explode after perforation, this has not been done under battle conditions. In Jutland, the nine-inch belt on the *Tiger* was the heaviest armor actually perforated. (Accurate data on the *Derfflinger's* Caesar turret armor which was pierced is not available.) The turrets constitute the ship's primary reason for existence and, due to the magazines, they are the most vulnerable parts of the ship, as borne out by the experiences at Jutland. The turret armor should therefore be equal or proportional to the maximum thickness of the belt, and the belt armor should be as nearly equal to the gun caliber as possible, considering the speed requirements and the number of guns carried. As noted from table

"A," our country has sacrificed speed for armor and guns, and as regards armor alone, our latest battleships are the best protected in the world. The Japanese and English have sacrificed protection for speed. The *Tiger* was barely saved from complete destruction when a shell pierced her main belt and almost hit her main steam line. Fewer guns should be carried rather than sacrifice protection if great speed must be obtained. These conclusions seem to be partially borne out by the design of the recent ships shown in table "A."

The two outstanding features of the Battle of Jutland are the excellence of the German gunnery at the beginning of the action, and the defective construction of the British ships. The *Indefatigable,* armed with eight 12-inch guns and the *Queen Mary,* armed with eight 13½-inch guns were blown up in the first few minutes of the action when five German battle cruisers with sixteen 12-inch and twenty-eight 11-inch guns faced six British battle cruisers (the four *Queen Elizabeths* were too far away to be considered in the battle at the time) with thirty-two 13½-inch guns and sixteen 12-inch guns. In other words, forty-four German guns of 11-inch and 12-inch caliber were pitted against forty-eight British guns of 12-inch and 13½-inch caliber. As pointed out in reference (c), if we leave out the use of smoke screens and the inferior position of the British as regards light, and admit the somewhat better gun play on the part of the Germans due to better shells, fuses and fire control, it is still hard to see how the above result could have been achieved had not the British ships been defective in construction, especially since the German ships engaged during this time escaped without vital injury.

The fact that hits on the turrets of the *Tiger, New Zealand, Princess Royal* and *Malaya* did no serious damage cannot be considered as nullifying the conclusions reached above, since the angles and velocities of impact of a certain number of all shells which strike the ship must necessarily be such that these shells do little damage.

In the latter part of the battle proper, the damage to the *Derfflinger* shows that however well this splendid ship stood up against ships of her own class armed with 12-inch and 13½-inch

guns, she was at last all but destroyed by the 13½-inch and 15-inch shells of the British battleships. This only proves the truth of the statement that a balance between guns and armor must be preserved if a ship is to stand up through a long battle at effective battle range.

In closing, let us go over several passages from reference (e) which vividly describe what it means for a major caliber shell to hit the armor on a warship. It will give an insight into the difficulty of designing any structure to withstand such punishment.

When a heavy shell hit the armor of our ship, the terrific crash of the explosion was followed by a vibration of the whole ship, affecting even the conning tower.

The shell hit with terrific force and burst with a tremendous roar that shook every seam and rivet.

Suddenly we seemed to hear the crack of doom. A terrific blow, a tremendous explosion and then darkness in which we felt a colossal blow. The whole conning tower seemed to be hurled into the air as though by the hands of some portentous giant, and then to flutter, trembling, into its former position.

OUR SYSTEM OF FLEET TRAINING

By Commander Russell Willson, U. S. Navy

THE naval powers differ among themselves in geographic position, resources, policies, racial characteristics and military tradition. As the modern navies have trained and fought over a period of many years, each navy under the influence of conditions peculiar to that nation has developed its own accepted methods for providing, maintaining and training its fleet. Among the several systems which have developed within the naval establishment of the United States and under which our navy operates, the system which most directly concerns line officers at sea is the system of fleet training.

There are some officers who will say—perhaps only half seriously—that we have little or no system in our fleet training. If system implies perfection of method, this, of course, is true. But accepted methods, established by authority and adhered to in practice over a period of years, do constitute the essential part of a system and officers of any considerable service in the fleet, who have seen the same cycle of exercises repeated from year to year, must realize that, whatever its deficiencies, there does exist in our service an established system of fleet training.

If this system is excellent it may be profitable to examine it with a view to seeing where similar methods may be applied in other naval problems; if it is unsatisfactory or only partially successful in producing a fleet ready for war, then we may even more profitably study it with a view to determining its weaknesses, and discovering means of overcoming them. The purpose of this article is to outline such a study and, if results warrant, to make definite proposals for improvement.

The subject of fleet training is a broad one into which enter considerations not of themselves matters of fleet training. The financial policy of the government as it affects the Navy, the recent naval treaties, foreign policies and international relations are matters of this kind. It is therefore desirable to make certain

assumptions and set definite limits to our discussion before proceeding further. For the purpose of this article we assume:

(1) That our fleet will remain at about its present size (built or building) for the next five years;

(2) That the fleet will be operated on about the same scale as at present, with perhaps some slight improvement in funds available;

(3) That the organization of the fleet and of the Department will remain about as at present;

(4) That our international relations will remain substantially as at present;

(5) That there will be no radical changes in the basic war plans.

The above assumptions concern matters connected with our subject which we will exclude from further discussion. On the other hand there are two subjects which might be excluded by a strict interpretation of the term "fleet training," but which from their nature must be considered. These subjects are recreation and material upkeep. Fleet training is largely a question of employment of time and no schedule of employment can be formulated without considering the time to be allotted for material upkeep and for recreation.

Having thus indicated the limits of our discussion it is desirable to set down the essentials which any reasonably satisfactory system of fleet training must cover. For some subjects this would be a difficult undertaking and one over which much argument might arise. But speaking in general terms, it is probable that most officers will agree that our system of fleet training must provide for the following:

(1) Material upkeep; (2) operating efficiency; (3) tactics; (4) gunnery; (5) communications; (6) logistics; (7) strategy; (8) recreation.

In this list no attempt is made to arrange subjects in order of importance—all are essential. Their relative importance and the time and effort which should be devoted to each are debatable, but this list may be used as a basis for discussing our present system of fleet training. However, before proceeding further it is desirable to sketch in something of the historical background which lies behind this system.

We have had a modern fleet for about twenty years. Our fleet

really began with the definite acceptance of the principle that fighting ships do not constitute a fleet unless they operate together as a fleet. From about 1904 until about 1910 our fleet, for all intents and purposes, consisted of from three to five divisions of battleships. There were also from one to three divisions of cruisers which generally operated separately from the battleships. Except for the cruise around the world the battleships were based in the Atlantic. Generally speaking, there was time and money for material upkeep. Gunnery was in a state of intensive development and there was very considerable tactical work—but directed principally toward excellence in the "parade ground" type of battleship maneuvers. There were no fighting instructions.

As destroyers and submarines became available in small numbers, they operated from time to time with the battleships, but it was not until 1915 that the fleet was organized into forces of various types and it was generally recognized that a modern fleet is much more than two squadrons of battleships. During this time the engineering competition was firmly established with resulting increase in operative efficiency. Gunnery continued to be the principal activity of the fleet and made consistent progress. Tactics was developing slowly but continued to be largely a matter of separate drills by battleships and by destroyers, with occasional joint operations including cruisers and submarines. In 1916 the first fighting instructions worthy of the name were issued by the commander-in-chief and the fleet was first drilled in fleet formations. The operations of the summer of 1916, culminating in the "battle" between the active and reserve fleets and the landing at Rockaway Beach, were the most advanced work of our fleet up to that time and promised well for the future.

Then came our entrance into the World War. Our part in this war was such as to delay in many ways the development of a well-rounded fleet, but it taught us invaluable lessons for future development. Among these lessons are the following:

(1) War involves a vast expansion of even the largest peace-time fleets.

(2) A war fleet is an extremely complex organization of all types, whose efficient coordination, before, during, and after battle, is the greatest problem of the commander-in-chief.

(3) To meet this problem there must be well conditioned ships, efficient communications, standard instructions and endless training.

In other words this war taught us, as nothing else could, the magnitude of the problem of training a modern fleet for war.

The period immediately following the war brought demobilization and curtailment, with the accompanying disorganization which included the division of our fleet in 1919 into two sub-fleets, one on each coast. In 1921 the mobilization or war organization was changed from the previous "type force" organization to the "task force" organization in the form of a battle force, scouting force, control force and fleet base force. This organization was particularly well adapted to the "built and building" fleet as it then existed. In 1922 this mobilization, with some modifications, was made the standard organization and once more we had one United States fleet. In 1923 the Office of Fleet Training was established in the Navy Department. In the meantime, the Arms Conference, by limiting capital ship tonnage, had further enhanced the importance of fleet efficiency as compared with fleet tonnage, and the development of planes and carriers had added new complications.

During this twenty-year period which has been briefly outlined we have developed our present system of fleet training. It is an annual or one-year system in which each year is a cycle of training. Ever since the establishment of the gunnery year, and the engineering year, there has been a fleet year. This fundamental of the system has remained unchanged.

But while the cycle of training has been continued at one year, there have been vast changes in the fleet work which constitutes that cycle. The problem of fleet training today is far different from what it was in 1904. In 1904, modern gunnery was in its infancy. There were three target practices a year and no engineering competition. The fleet, composed almost entirely of battleships, could go through practically its whole repertoire of evolutions in one day. There were no extensive strategic exercises for there were few if any scouts, and only a few "war games" on a small scale. There were no radio, no smoke tactics, no planes or carriers, submarines, depth charges, bombs, gas, or destroyers. When things went wrong there was money and time for overhaul. Today gunnery exercises have multiplied until there are from seven to nine forms of practice for each type of vessel. The engineering competition has been established with its full power and bonus runs and mandatory periods of overhaul. Strategic exer-

cises require wide dispersion of forces and considerable periods of time for their execution. Tactical exercises are no longer questions of drilling battleships. There are many types—each with its own type tactics—and all to be coordinated in the tactics of the fleet. Fleet formations may be 100 miles in diameter and the most elementary training in fleet evolutions is a matter of weeks, where before it was a matter of days. Logistics and recreation have made increased demands in the fleet schedule, and with the increase in fleet activities and the decrease in navy yard funds, it is becoming more and more difficult to find time for necessary material upkeep.

In other words, our problem of fleet training has grown enormously in the past ten years and every year is making increased demands on the time, skill, energy and devotion of the fleet. So far we have made no change in the one-year system other than to cram more and more into each year's schedule. Is this annual system sufficiently elastic to stand the constant pressure of increased activities, and, if so, when shall we reach its elastic limit? As any system is best judged by results, let us make a brief estimate of the present condition of our fleet in the essential elements of training for war.

(1) *Material Upkeep:* Due to lack of funds the periodic overhaul of ships at the navy yards has been reduced to such an extent that more and more time is required for material upkeep of units operating with the fleet. The prime importance of allowing sufficient time for this purpose is recognized and emphasized by the Department and by the commander-in-chief, while at the same time every effort is being made to obtain more money for the yards. Periods amounting to nearly one third of the schedule are allotted to upkeep and they should be sufficient. But do the ships actually get that much time? As a general proposition they do not, and here lies the difficulty—the difference between the time allotted on paper and the time actually available in practice. There is a great difference—and it is well recognized in the fleet, but the best efforts of those in authority seem unable to reduce it. The cause is also recognized—certainly it is discussed at length—unforeseen calls for ships. As a matter of fact such calls for ships have averaged about the same over many years, and are unforeseen only in that they cannot be named and described in advance. The truth is the schedule under the present system is so "tight" that we cannot afford to see them and allow for them; we must continue

to hope that next year will be different. The schedules necessary under the one-year system do not give enough actual, *bona fide* days for material upkeep.

(2) *Operating Efficiency:* Operating efficiency is largely dependent on material upkeep. But considered separately, the best way to gain operating efficiency is to operate, and the ships of our fleet do operate. The engineering competition is a vital part of our fleet-training system and while the necessary records take only the time of individuals, the various trials take time in the fleet schedules. They are the real test of battle engineering efficiency and last year twenty-five per cent of destroyers and thirty-four per cent of all ships eligible did not complete their prescribed full power trials. How many ships that did complete their trials had the required week before and after their runs? A reason—not the only reason—but an important reason lies in the schedules of our yearly system. They are of necessity too "tight."

(3) *Gunnery:* Using "gunnery" to mean all exercises in the use of the elements of attack—gunnery has maintained for twenty years the primary place in our system of training for war—and our gunnery efficiency shows it. Gunnery is the best organized of fleet activities. It has the most highly standardized exercises, the best records, the most comprehensive plans and the most frequent and definite tests of efficiency and progress. It has also the most prestige. The time has been, and recently, when to suggest the equal importance of any other element of fleet training was to verge upon heresy.

We have seen that the number and complexity of gunnery exercises have steadily increased. They will probably increase further with the development of air craft. None of the present practices can well be dispensed with; in fact, it would seem desirable to increase the experimental and advanced practices. This would require more time for gunnery, which already is the element of training most favored in the fleet schedules. But without any new forms of gunnery exercises, is sufficient time available under the present system of existing practices? The consensus of opinion seems to be that it is not. This observation is based largely on experience in the scouting fleet—whereas conditions in the battle fleet are probably more favorable. All fleet exercises should be conducted with celerity and precision; but we know that target practices are like propellers—there is a maximum speed above

which there is marked loss of efficiency. The writer knows not only a single practice, but whole sections of the gunnery schedule that have been "speeded up" beyond the maximum limit of efficiency. He may have been unfortunate, but he is willing to risk the statement that many of the responsible officers concerned believe our gunnery exercises have frequently suffered by too much "speeding up," in an endeavor to keep up with the schedules necessary under the present one-year system.

(4) *Tactical Training:* We have long been backward in the tactical training of our fleet. Slow in recognizing the magnitude of the problem as it has grown by leaps and bounds in the modern fleet, we have delayed in according it a position of importance coordinate with gunnery. Fortunately, there are signs that tactics is now gaining recognition. In the past tactics has suffered from lack of standard instructions, lack of records, lack of planning and tests of efficiency, lack of a "home office" in the Department, but most of all it has suffered from lack of time in the fleet schedules. With the establishment of the Office of Fleet Training and the support of the commander-in-chief, many of these shortcomings are in course of being rectified. But neither the Office of Fleet Training, nor the commander-in-chief, can put more days into the year, and tactics cannot get more time in a yearly schedule unless it displaces something else. The schedule allots time to tactical exercises, but there is not enough time available or it isn't used for the purpose assigned. We find a light cruiser in commission a year and a half that has been in formation two hours, a division of destroyers that in six months has never once drilled as a division and has been in squadron formation just three times in going from point "X-Ray" to Hampton Roads. The tactical training of our fleet for war has suffered in the past, is now suffering and will continue to suffer because of the "tight" schedules of the present system.

(5) *Communications:* Our system of fleet training fully recognizes the importance of communications. It is a lesson deeply impressed by the World War. That our communications are eminently satisfactory is not true, but the problem is recognized. Fortunately, communications in one form or another enter into all forms of fleet training. For this reason communications are not dependent upon an allotment of time in the fleet schedules. They are always in the schedule. However, we should bear in

mind that for this same reason, any form of training neglected in the schedule means that the communication problems peculiar to that activity are also neglected. In other words, a schedule that crowds out or unduly compresses strategic operations, fleet tactics, or advanced gunnery is deficient in communication training.

(6) *Logistics:* Logistics is an element of fleet training which is involved in all forms of fleet activities. Its importance is thoroughly recognized, and its various problems are receiving more study than ever before. It is true that the larger phases of logistics are matters of planning and administration, but what may be termed practical logistics holds a secure place in all fleet schedules. Ships must fuel and provision and the time for these operations cannot be reduced below certain limits, no matter how crowded the schedule. Even here we can see the effect of lack of time. Fueling at sea is a practical form of logistic operations which is important in any oversea campaign, yet we have had precious little exercise or training in such operations.

(7) *Strategy:* Strategy and strategic operations are recognized in our fleet schedules. As far as the training of subordinate commanders is concerned, strategic operations are more closely connected with the mission of the scouting fleet than with the mission of the battle fleet. They do, however, enter into the more advanced fleet maneuvers. We have had a scouting fleet for some years now and have had our eyes opened to the value of practical experience, as distinguished from theoretical study, in strategic operations. There have been strategic problems from time to time and we have somewhat standardized our practice. But have we made reasonable progress? Of course it is easy to find fault, but whatever the cause, it does seem that the fleet has not gained much practical experience in scouting and kindred operations. In the theory of scouting, officers are probably better grounded than ever before, but there are practical problems, communications, station keeping, concentrations, changes in plans and methods in which the fleet has not built up a fund of records, or of practical experience—in which the fleet is not trained.

The cause of our lagging behind in practical strategic training lies in the lack of ships, lack of time and possibly, in recent years, in lack of fuel. As to fuel, we can but do our best. As to the small number of ships available in the scouting fleet—notably during the past summer—we find unforeseen calls for destroyers and

the midshipmen's cruises are responsible, a fact which suggests that the schedule should recognize this condition, if possible, and shift to another period such operations as require practically all ships, leaving the summer to the training of smaller units—which brings us back to the question of the schedule and the time available for strategic training. Under the present system by which we attempt a little of everything each and every year, the fleet does not have enough time, when ships are available in force, to train the scouting fleet in its mission.

(8) *Recreation:* Recreation, in the form of athletics—queer as it may seem—is probably, next to gunnery, the best organized form of fleet activity. There seems to be no danger that it will not continue to receive its full weight in the apportionment of time, and in the demands upon the efforts of ships and officers. In fact, if there is any danger, it would seem to lie in the possibility of overdoing this form of fleet activity. Another form of recreation which perhaps more directly concerns the fleet schedules is the periodic return of the ships to their home ports, usually at the holiday season. This period is also available for a certain amount of upkeep, provisioning, and so forth, but it does represent a definite period which should not be reduced below three weeks and which, in the schedule, must be charged primarily to recreation. While there seems to be considerable pressure to reduce this period, due to the pressing demand for more working time, our present system has so far met this requirement.

The above brief discussion of the present condition of fleet training under the one-year system may be summarized as follows:

(1) As regards operating efficiency, communications, logistics and recreation, conditions are satisfactory and the one-year system is workable.

(2) As regards gunnery the conditions are fairly satisfactory and the one-year system has so far "stood up" under the expansion of gunnery activities. However, there is considerable evidence that the limit has been reached, if not passed, and that the "speeding up" of gunnery exercises necessary under the present schedules has in some cases seriously lessened the value of the exercises.

(3) As regards material upkeep, tactics and strategy, conditions are not satisfactory and the present one-year system is not work-

ing well. Apparently a point has been reached at which it fails to give sufficient time for developing these elements of fleet training.

It seems, therefore, that our problem has attained such proportions that we can no longer meet it by a one-year cycle of training. If we attempt the impossible and continue to crowd more and more into each year's schedule, conditions will grow worse instead of better. Our fleet, under such a system, can never closely approach the condition of a trained fleet. It is the realization of this fact that accounts for the disconcerting thought that we all have now and then: "Are we getting anywhere—or is the real fleet at the end of the rainbow?"

If we are ever to have a well trained fleet, must we not lengthen the cycle of training? If the period chosen is sufficiently long, about the middle of the period we may expect to have a fleet well grounded in fundamentals and ready to go ahead, and at the end of the period, to have a reasonably well trained fleet with an accumulation of permanent records and experience in advanced fleet exercises never attained under our present system. Would not such a system give us more progress over a period of years, and a higher average readiness for war than has been or can be attained under our present one-year system?

For such an increased cycle of training, the period which suggests itself is two years. Eighteen months is probably too short and would throw the schedule out of step with the seasons. Three years is too long and would exceed the usual tour of duty of the higher officers.

What are the difficulties and disadvantages of changing to a two-year system? It has been said that much of our progress in gunnery and engineering has been built upon the principle of annual competition. This is true, but nothing in the two-year system of fleet training conflicts with that principle. Wherever there is or can be annual competition in engineering, gunnery, communications, or athletics, let that competition continue for the work done each year. It is not necessary that each year's work should be a repetition of the preceding year, but merely that each year's work should be competitive.

One officer who is concerned with fleet training brought up the question of our constantly shifting personnel, intimating that under a two-year system this difficulty would be doubled or at least con-

siderably increased. There is ground for difference of opinion here, but one should watch his perspective before taking sides. A battery officer with a good gun pointer knows that the chance of losing him in two years is about double the chance of losing him in one. Granted. But our problem is one of fleet training and it is more difficult to train captains and admirals than to train gun pointers. As few officers go to sea for less than two years, their cruises will cover a whole period of fleet training. Some will start in the middle of the period, others at other times, but all responsible officers would hardly be changed at one time. Furthermore, all knowledge and experience does not leave the ship when the captain is detached. Fleet training is the development of team work among ships and larger units—it is more than training officers and men as individuals. Under existing conditions in our service there will always be a large turn-over of personnel, but in the writer's opinion, the effect on fleet training will be no more serious under a two-year, than under a one-year system. In fact, it may be that the two-year system will tend to give more permanency of personnel, in that more definite planning will be possible. To those who cannot agree with this, the answer is that the advantages of the two-year system outweigh any disadvantages due to increased difficulties with shifting personnel.

Another possible disadvantage is the difficulty of laying out a two-year program with one-year appropriations. It is true that a radical decrease in fuel or men might force modifications in the second year of any training program, but there is less probalility of such changes now than there was two or three years ago. In fact, we have assumed earlier in this article, that the Navy, during the next few years, will be operated on about the same scale as at present. However, if there should be changes of plan forced upon us, by curtailments of appropriations, or other unforeseen conditions, the result on the training of the fleet would be no more serious under the proposed, than under the present system.

These questions of annual competition, of annual appropriations, and of shifting personnel, may be considered as weighing for or against the two-year system, but actually they are not of great importance. The real test of the proposed system is whether or not it will equal the results of the present system where satisfactory, and better those results where not satisfactory.

It has been stated that the one-year system is satisfactory as regards operating efficiency, communications, logistics and recreation. Here the two-year system would produce results equally good if not better. In fact, practical experience in problems of communication would be increased with the progressive training in strategic and tactical operations possible only under the two-year system.

Under the one-year system the results in gunnery have been satisfactory, except for recent signs of too much speeding up in an effort to keep up with the schedule. With probable gunnery development in connection with aircraft there will soon be demands for new practices, and, if we are not to lag behind other powers, there must be more experimental practices. Thus the cycle of gunnery training, already a tight fit in the annual schedule, is tending to expand. On the other hand, the pressure for other forms of training, notably tactics, is tending to compress the time for gunnery, in fact, has actually done so in the proposed plans for next year's schedule.

The two-year system proposes to meet this condition by expanding the cycle of gunnery training from one year to two. This does not mean that the "weeks per year" for gunnery would be reduced by half. They would be reduced somewhat—for in no other way can additional time be found for upkeep, tactics and strategy—but the net result will be a better gunnery schedule. Under the proposed conditions we may return to thoroughness rather than speed in gunnery exercises. There will be time for more experimental practices, and a place in the schedule for the resulting standard exercises when they have been developed. Gunnery will have room to grow.

The present one-year system has not given satisfactory results as regards material upkeep, tactics and strategy. The schedule, of necessity, is too tight; there is not enough time for them, and in tactics it has been impossible to establish a progressive plan of training, beginning with elementary work and progressing to advanced exercises—as has been done so successfully in gunnery. The two-year system offers some hope for these backward elements of fleet training. It is no panacea for all our ills, but it does offer these elements more time, and this plan does more than merely increase the "weeks per year" for strategy and tactics. It

"eases up" the schedules and makes them more flexible. The commander-in-chief can allot time with more consideration to outside circumstances, and the periods for each branch of training can be longer.

In discussing this subject with two officers whose opinions are entitled to considerable respect, one said, "The trouble is, we try to run before we can walk." The other said, "Somehow we seem to start about the same place every year, get only so far, and then start over." At first these remarks seem contradictory, but they merely apply to different phases of the same problem. The training of the fleet may be conveniently considered as comprising four stages—which, for lack of better terms, may be described as "freshman," "sophomore," "junior," and "senior." The first remark quoted is a comment on the fact that we omit the "freshman" stage of training. The second remark touches the fact that every year we start as "sophomores," progress to the stage of "juniors," but never get to be "seniors," because, under our present system, we must again start as "sophomores" the following year. We now vibrate between a "sophomore" and a "junior" status in fleet training. Is it not worth while at least to try a system which permits us to start as "freshmen" and finish as "seniors"? The two-year system will do this.

If we accept as logical this division of training into four stages, we will divide the two-year cycle into four periods of six months each. This fits into the established custom of our service very well. There has always been a time of inactivity in our fleet during the latter part of December, and there has generally been, until this year, a similar time the latter part of June. These times would mark the end of the six-month periods.

The work in each of these periods should be planned and carried on so as to bring forth a well balanced development of all elements of fleet training during that period and a logical progression into the next period. Tactics and strategy should not be favored at the expense of gunnery and operating efficiency—nor vice versa. The proper portion of the six months should be assigned and given to material upkeep. The distribution of time among the different elements should be made by the commander-in-chief with the assistance and cooperation of the Office of Fleet Training.

The following is suggested as a tentative division of the twenty-six weeks composing each six months period:

Material upkeep	9 weeks
Gunnery	5 weeks
Tactics and strategy	6 weeks
Cruising, holidays, and miscellaneous	6 weeks
Total	26 weeks

It should be noted that these figures represent time in which the various subjects would have priority, and that other training, not in conflict, could go on. Thus there can be gunnery training during upkeep and tactics during cruising.

The first period should begin on July 1, as does the present fleet year. Changes in the commander-in-chief and other high officers should be made at this time, and, in general, this date should be considered appropriate for changes in personnel and in the units of the fleet. This would be the initial point in the cycle of fleet training, but the efficiency of the fleet would by no means drop to a dangerously low mark. It would be neither practicable nor desirable to change all officers or ships' companies at once and while there must be a beginning under any system, there would be at this time a considerable carrying over of experience, training and permanent records from the advanced exercises of the preceding period.

The first period should be devoted to elementary training. This does not mean that the units of the fleet would not progress beyond the simplest forms of training during this period, but merely that they should start at the beginning and train progressively. About one week in three should be allotted to material upkeep. Gunnery, in this period, should include the first quarter of its cycle of training, beginning with the elementary forms of practice. Tactics should begin with the school of the ship, progress to the school of the division, and, in the case of destroyers, should include drill of the squadron as a single tactical unit. In the scouting fleet this period should include simple strategic exercises with the particular object of giving practical experience in communication, station keeping, concentrations and change of plan. The work of this first period would be done in areas now used during summer and fall, except that it would probably pay to have the scouting fleet

go south about the middle of October for six weeks in the vicinity of Guantanamo and the Bay of Gonaive.

The second six-month period should begin after New Year's and continue with about the same division of time as before; that is, one third for material upkeep and the remainder for cruising and training. This period should continue the gunnery schedule and advance it to the half-way mark. In tactics it should include for the battle fleet formations and maneuvers of the battle line, anti-submarine screening, and training of destroyers, submarines and aircraft in connection with the battle line, this training to include the simpler forms of smoke tactics and night and day attack. For the scouting fleet this period should include some training in formations and maneuvers of the battle line in order that the battleships may be able to take their place in the battle line if necessary, but more particularly should it include training in extended formations, concentrations and surprise attacks, with special emphasis placed on communication problems. The scouting fleet during this period should undertake more elaborate strategic exercises in combination with tactical training. During this period the scouting fleet and control force will be in southern waters. The battle fleet and fleet base force should unite with them for a part of the winter. However, when the whole fleet is assembled advanced fleet problems should not be attempted. The forces available should be used to complement each other and to supply sufficient ships to make intermediate training more realistic. Among the exercises to be undertaken at this time should be control and fleet base force operations and joint operations with the Army.

The third period should begin with July and include the summer and fall. Training should begin where the second period left off. If practicable, the whole fleet should be brought together for a part of this period in order to provide forces for training the larger units properly. This is particularly true as regards the strategic training of the scouting fleet. If not practicable to unite the fleet during this period, it may be desirable to advance the gunnery schedule more than would otherwise be done, in order to give more time for advanced tactics and strategy during the fourth period.

The fourth period should begin after New Year's of the second year and include winter and spring. It is the period for advanced training when the several parts of the fleet, as a result of progressive training during the three preceding periods, are ready to be welded together into one fleet. This period should include the usual proportion of time for upkeep and should complete the most advanced gunnery exercises. However, it is primarily the period for tactical and strategic training in the form of fleet drills, evolutions and operations. The period should end with a test mobilization and a series of advanced fleet operations under war conditions.

We have attempted only to sketch the bare outline of the work to be undertaken in the four periods which are to compose the two-year cycle of training. The details of the plan to be set forth in the fleet schedules will require all the resources of the commander-in-chief and the Office of Fleet Training. But the fundamental principle must always be kept in mind—start at the beginning and proceed logically and at efficient working speed toward the objective of a fleet trained for war.

In this article we have undertaken to examine our present system of fleet training, to estimate the results obtained under that system and to propose an improved system. We may summarize as follows:

Present System.—(1) Our present system of fleet training is an annual or one-year system in which we attempt a complete cycle of training each year.

(2) The principle of this system has remained unchanged for twenty years.

(3) Since the war this system has given reasonably satisfactory results in operating efficiency, communications, logistics and recreation.

(4) It has given fairly satisfactory results in gunnery but recently the crowded schedules of this one-year system have forced gunnery into a "speeded up" condition, somewhat beyond the limits of efficiency.

(5) The present system has failed to give satisfactory results in material upkeep, tactics and strategy.

(6) The schedules under the present system are crowded beyond the possibility of any additional fleet work.

(7) Under the present system we have begun to exceed the most efficient speed for fleet work.

(8) At present we vibrate between two stages of intermediate training, without ever passing through an elementary stage, or attaining an advanced stage.

Proposed System.—(9) It is proposed to change the cycle of training from one year to two years—to adopt a two-year instead of a one-year system.

(10) Under the proposed system the gunnery schedule would be enlarged to permit of additional practices, and, as expanded, would be extended over two years, thus "easing up" the schedule, and giving some much needed time to other branches of training.

(11) The additional "weeks per year" thus obtained from gunnery would be divided among material upkeep, strategy and tactics, which have suffered most under the present system.

(12) The two-year cycle of training would begin July 1 and comprise four periods of six months each.

(13) The following division of time in each six-month period is suggested:

Material upkeep	9 weeks
Gunnery	5 weeks
Tactics and strategy	6 weeks
Cruising, holidays, and miscellaneous	6 weeks
Total	26 weeks

(14) The first period would be for elementary training, the second and third for progressive intermediate training, and the fourth for advanced training.

(15) The training plan would be balanced and progressive throughout each period and from one period to the succeeding period.

(16) The final period of advanced training would end with a test mobilization and grand maneuvers under war conditions.

This two-year system of fleet training is proposed with no illusions as to its perfection. It is no panacea for all the ills of the Navy, but it holds promise of improving present conditions and building for the future. It is definite, it is constructive, and it aims, if only by the discussion it may bring forth, to advance the readiness of our fleet for war.

JOINT ARMY AND NAVY OPERATIONS
PART V

By Captain W. S. Pye, U.S.N.

IN A previous article of this series, Joint Army and Navy Operations, Part IV, published in the Naval Institute Proceedings for March, the general subject of preparations for a specific oversea expedition was discussed, but because of limited space, could not be discussed in detail. There is, however, one phase of such preparations which is considered of sufficient importance to warrant further consideration; this is, the embarkation and the preparations therefor.

In these preparations the Army and Navy personnel of the joint expedition come into close contact for the first time and it is essential that there shall be a complete and thorough understanding as to respective duties and responsibilities. This is particularly true because, according to existing policy, the provision and operation of transports are in some cases under the War Department and in other cases under the Navy Department.

The present *policy in re Provision and Operation of Transports* may be expressed as follows:

The War Department is responsible for the provision of transports for Army Expeditionary Forces unless by special agreement, approved by the Secretary of War and Secretary of the Navy, such responsibility shall have been accepted by the Navy Department.

The Joint War Plan for any possible war shall contain a definite statement as to the responsibility for the provision and operation of transports.

Although no definite policy in respect to the assignment of this responsibility exists, it is reasonable to suppose that such policy if stated would be about as follows:

Transports for Army Expeditionary Forces will be provided and operated by the War Department for expeditions in the con-

duct of which no enemy naval opposition is to be anticipated. In case enemy naval opposition is anticipated the Navy Department will be responsible for providing and operating transports for Army Expeditionary Forces.

During the World War our troop transports were provided at first by the War Department, but at a later date were taken over by the Navy. It is undesirable to have two government agencies engaged in the same work and, consequently, definite decisions in advance for each possible war should be made.

The Provision of Transports.—In expeditions in which the Army has the responsibility for the provision of transports the requirements are not apt to exceed the capacity of the vessels of the Army Transportation Service; therefore, such provision is not difficult. Even should the requirements exceed the capacity of the Army Transportation Service the requirements could be easily met by charter from the Merchant Marine.

It is quite different in cases where the Navy has the responsibility. Usually this condition will exist only in expeditions against a major power. In moving an army of sufficient strength to be effective against a major power, the demands will be excessive, and to make matters worse, the Navy, at the same time, will have to meet additional demands for auxiliaries for the fleet and for transportation for Marine Expeditionary Forces.

The transports of the Army Transportation Service and of the Navy are inadequate to meet the needs of a major expedition and the deficiency must be made up by vessels of the Merchant Marine. Although the United States Merchant Marine can not compare with the British Merchant Marine in the possession of large fast passenger liners, we are, fortunately, much better supplied with shipping now than we were before the World War, and we have vessels which, though not large or fast, can be converted into fairly satisfactory transports. Large passenger liners are fast and more comfortable for the troops than are the smaller, slower vessels. When speed is essential and the landing is to be made in a friendly port, they are most desirable.

In expeditions where enemy opposition is to be anticipated, the smaller ship may be more suitable because of less draft, relatively greater boat equipment and storage spaces, and consequently greater flexibility in the allocation of troops to specific operations.

The importance of the initiative in war is well known and to gain this advantage it is essential that the provision of transports from the Merchant Marine be planned with the greatest degree of detail.

Plans for the provision of transports must include:

(1) *Inspections, to determine suitability.*
(2) *Conversion plans.*
(3) *Repair and alteration lists.*
(4) *Plans for the provision of personnel.*

Inspections of vessels of the Merchant Marine to determine the availability of such ships for war service are made by the Army and Navy Joint Merchant Vessel Board. From the vessels reported suitable for use as transports, and from lists of home ports, routes, etc., a tentative selection of transports for use in differing situations must be made. In order to reduce conversion plans and estimates of capacities to a minimum, ships of the same class should be selected as far as practicable.

So far in this discussion reference has been made only to troop transports, but it is equally important to provide for animal transport and material transport in the same manner.

The suitability of vessels for service as transports depends upon their ability to meet certain limiting conditions in regard to:

(1) *The speed required.*
(2) *The distance to be steamed without refueling.*
(3) *The probable sea conditions.*
(4) *The climatic conditions.*
(5) *The draft at embarkation and debarkation ports.*

These may be considered as limiting conditions, and vessels which fail to meet the required conditions can be omitted from further consideration. The effect of these conditions can be seen in the choice of transports by Great Britain for use across the English Channel and by the United States for service across the Atlantic.

The British chose small fast steamers with no accommodations for berthing or feeding the troops nor space for carrying other than marching equipment. For trips across the Channel this was the most efficient type. On the other hand the United States re-

quired the largest and fastest ships available in the world. The troops had to be quartered and fed for a week or more. As much equipment as possible accompanied the troops. For each expedition, therefore, careful consideration must first be given to the limiting conditions mentioned above.

The vessels which are suitable so far as the above limiting conditions are concerned must next be examined from the point of view of availability. The following points must be considered:

(1) *The regular route, including greatest distance from any fitting out port.*
(2) *The home port.*
(3) *Whether ship is required by Navy in capacity of auxiliary.*
(4) *The amount of conversion required.*
(5) *The alterations and repairs required.*

After this examination is completed it will be found that suitable available ships are extremely limited; there may, however, be some choice.

From the suitable available vessels choice should be made giving further consideration to:

(1) *Capacity for troops.*
(2) *Suitability of boat equipment.*
(3) *Capacity for additional boat equipment, or stowage of small lighters.*
(4) *Capacity for storage of troops' equipment.*

The previous considerations apply only to material. It is equally necessary to plan for the provision of the required personnel.

The first decision to be made is whether or not the transports are to be commissioned as naval ships. In general, it may be accepted that a situation which requires the Navy to provide the ships will require the Navy to man the ships. If operated by the Army the regular Army Transportation Service or Merchant Service crews should be suitable, but even in this case the Navy should provide personnel to advise the captain as to formations, etc., and to assist in handling communications, especially signals.

To provide officers and crews for transports to be taken over by the Navy there may be employed:

(1) Regular naval personnel.
(2) Retired naval personnel.

(3) Naval reserves.
(4) Such of the Merchant Marine personnel as will enroll in the reserve or enter the regular Navy at the time.

Regular naval personnel should be used as sparingly as possible because all available regular naval personnel will be needed to man combatant ships. It will be necessary to provide some regular personnel or well trained reserves to handle communications, and to advise the ship's officers as to formations, maneuvers, etc. Some retired naval personnel and reserves may be available but most of these will be required in the combatant ships or fleet auxiliaries. Every endeavor should be made to keep the officers and crews of ships intact by enrolling officers and crews in the Naval Reserve. The Naval Reserve Bill now before Congress provides for a Merchant Marine Naval Reserve, and, if passed, will greatly assist in the provision of personnel by enrolling Merchant Marine officers and men in this reserve in time of peace.

The preparation of conversion plans and lists of alterations and repairs is a matter of great importance. Most vessels available and suitable for use as transports require not only the erection of standee bunks, but the provision of additional galleys, storage for fresh provisions, evaporating apparatus and sanitary arrangements. If this work is to be accomplished rapidly, plans must be ready. In the present inactive state of the Merchant Marine many vessels suitable and available for transports are laid up. For these and even for some ships in operation, lists of alterations and repairs are essential. In the World War it was ten weeks before we started a troop ship to France. Such a state of unreadiness may be fatal. Unless we are to yield the initiative to an enemy we must insure against delays in the provision of transports by taking steps similar to those above described.

The Ports of Embarkation.—For minor expeditions the necessary wharfage and storage can readily be obtained by temporary lease, but for major operations the embarkation of the expeditionary force is but the first of a series of such expeditions and, as the troops overseas increase in numbers, the demands for wharfage and storage will likewise increase.

The provision of suitable ports of embarkation is a responsibility of the Army. These must contain not only adequate piers, load-

ing facilities, storage, camp sites, etc., but, equally important, adequate railroad facilities from supply areas, sidings and freight yards.

From the naval point of view the ports must have ample anchorage space so that vessels can anchor while waiting to load or to sail after loading.

The Loading of Transports.—The Army authorities are responsible for determining what troops shall be embarked and what equipment and stores shall be loaded in each transport, except that the number of troops shall not exceed the allotted carrying capacity and that the equipment and stores shall not be in such quantity nor stowed in such manner as to endanger the stability or water-tight integrity of the ship.

Relation of Loading Plans to Plan of Operations.—It is needless to mention that the ports of embarkation should be those best located from a strategical point of view. While the selection of such ports bears a definite relation to the plan of operations, it has not as intimate relation to such operating plans as have the loading plans. Before effective loading plans can be made it is essential that the major points of the operating plan be known.

The first and most important decision upon which the loading plans depend is whether or not preparation is to be made for landing against opposition.

When conditions similar to those of the World War exist, that is, the landing to be unopposed and the troops disembarked and equipment and stores unloaded in a friendly, well-equipped port, the troops to be embarked and equipment and stores to be loaded are questions only of availability, priority and capacity of the transports. On the other hand, if the landing is to be made against opposition, the loading plans must be such as to insure the effective execution of the operating plan.

When troops are to be landed against opposition the following decisions should be made before preparing the loading plans for the expedition.

(1) *The landing places.*
(2) *The conditions of disembarkation.*
(3) *The number, composition and organization of the troops to be landed at each place.*

(4) *How many and what troops are to be landed at each landing in the first wave.*
(5) *The required rate of reinforcement.*
(6) *How much artillery, aviation, tanks, engineer material, etc., will be required and when.*
(7) *How much additional equipment, ammunition, stores, water, etc., will have to be landed during a day.*

Having determined these points the naval commander and army commander should decide upon the disposition of transports which appears most advantageously to meet the conditions. Should there be available special equipment for landing such as small lighters, beetle boats, etc., the distribution of the facilities should likewise be decided upon.

Transports should be selected such that their:

(1) *draft permits the attainment of a favorable position for disembarking the troops.*
(2) *boat or lighter equipment is adequate for the troops to be landed.*
(3) *booms or cranes are capable of lifting the heaviest equipment.*
(4) *respective capacities permit the embarkation of complete units of organization.*
(5) *storage capacity is adequate for the equipment and stores required.*

If we are to attain efficiency in preparation for overseas expeditions studies should be made during peace to determine the capacities of many of our standard types of ships under possible war conditions.

Loading Plans.—With the transports selected and with the previously mentioned decisions as to troops and equipment to be embarked the Army Quartermaster Corps prepares the loading plans. It is impossible to give too much consideration to these plans. Many expeditions have been seriously reduced in efficiency through failure to realize the importance of proper loading. Effective landing operations conducted from a transport require that organization units be embarked as a whole and that everything which the unit requires for effective operation on shore be

embarked with it, including transport, camp equipment, supplies and ammunition.

The units of organization usually considered are a battalion of infantry, a troop of cavalry, or a battery of artillery. More than one unit may be embarked, but each unit should be complete.

To secure the tactical use of all arms, loading should be so arranged that the transports at each landing place shall have on board, troops of all arms and equipment and stores of all kinds. In general, the equipment or stores required first should be loaded last in order that they may be unloaded most readily. From this it is apparent that an attempt to overload a transport usually results in leaving some valuable equipment on shore because of lack of space or in a makeshift stowage in order to get it all on board. Overloading personnel is equally bad. Troops confined to a ship for a period of some days, unless suitably accommodated, lose much of that vitality which is so essential to success in a landing operation. That troops shall be suitably quartered and equipment and stores suitably loaded is so important that a sacrifice in total number of troops should be made, if necessary, in order to insure a satisfactory condition.

The order in which ships are to be loaded should, so far as practicable, be left to the Army. In this respect, however, there will be need for constant liaison between the commander of the army expeditionary force and the naval commander. In the nature of the case we are considering, the naval commander will be beset with many difficulties concerning the transports. Most of them will have green crews and officers of little experience in work of this nature; many will require extensive conversion, repair or overhaul; all of them will need ship's stores, fuel and, possibly, drydocking. If all of these activities, and the loading of troops and army equipment and stores, are to be accomplished in the shortest time, there must be the closest cooperation between the staffs of the army and naval commanders, and this cooperation must include mutual confidence, a spirit of good will, and willingness to reach solutions by compromise.

Assignment of Quarters and Cargo Spaces.—The quarters available for army officers and the compartments to be used by troops should be definitely marked by the Navy Department on the ship's plans. The assignment of army spaces to individuals or units should be made by the army officer in command of the troops.

In expeditions where landing against opposition is contemplated it is essential that the troops be quartered by units of the organization, even though the unit be as small as a squad. There is no greater aid to morale than confidence in one's companions and this confidence can be gained only by close association. Any man is braver among friends than among strangers.

The arrangement of stowage for equipment and stores made by the army quartermaster should be followed unless such stowage endangers the stability or water-tight integrity of the ship. Great care should be taken to insure that the contents of each storeroom or hold are recorded. Plans are always subject to change and unless the location of every item is known, disorder may follow any attempt to change the plan of unloading.

In stowing artillery it is preferable for it to be retained on deck or in such space that it can be cared for and prepared for firing before arrival at destination. All wagons, caissons, or other rolling stock should be stowed without removal of wheels. So far as practicable every piece of equipment should be ready for immediate use. The medical personnel should be so divided that the troops on each transport will have medical attention on board and on shore. If the boat equipment is not adequate to land the heavy equipment, portable flat bottomed boats or small lighters should be obtained. Material for building piers should also be provided.

Animal and Cargo Transports.—Such animals as are required for the effective operation of the troops must accompany them. Due to the many difficulties attending the use of animals they should be displaced as far as possible by motor transport. There are, however, many situations in which animal transport may still be superior. If animals for supply trains are to be transported in large numbers, special transports should be provided for them. On long voyages horses require stalls of sufficient size to permit them to lie down. They also require exercise each day and this must be arranged for by allowing suitable space for exercising them.

Storeships are readily obtained from vessels of the Merchant Marine. It is not essential that these be manned by navy crews, but such should eventually be done. In loading storeships, stores for the same army service should, if practicable, be placed on one transport. If stores for more than one service are loaded on one

transport there should be a representative of each such service on board who is familiar with the stowage of all articles for his service.

Responsibility after Loading.—When the transport has completed loading, she should clear the pier at the earliest moment so as not to interfere with other vessels to be loaded. She will have been assigned a berth or anchorage by the naval commander and should proceed to it. The naval commanding officer is responsible for the safety and discipline of the ship. The officer commanding the troops should have been informed of the ship's routine, of the guards required for army stores and equipment, and of the ship's regulations applicable to army personnel.

If possible, prior to sailing, the army troops should be exercised in landing operations, using the same conveyances that they will use in actual landing operations against the enemy. They should also be instructed in their duties at "Fire Quarters" and "Abandon Ship."

If, through shortage of trained naval personnel, it is necessary to assign some army personnel as lookouts, they should be detailed and thoroughly instructed in their duties.

Responsibility for Destination, Route, Speed and Time of Sailing.—The destination of the troops is manifestly a strategical decision and one which will be made by the officer in command within the theater of operations. As has been pointed out in a previous article of this series in which the subject of command was discussed, our regulations on this subject are vague. There can be little doubt but that the destination should be determined by a joint commander of the army and navy forces within the theater of operations. Whether such joint commander would be a naval or army officer depends upon the nature of the war and a consequent determination of which service has the paramount interest. After the destination is determined upon and ordered, the naval commander is responsible for the time of sailing, the speed and the route.

The naval commander of a force containing transports on which a large expeditionary force is embarked will probably be embarked in a vessel of the escort. There would also be a convoy commander embarked in one of the ships of the convoy who would be in tactical command of the convoy. The naval commander is re-

sponsible for arranging with the commandant of the naval district for sweeping channels, and for additional surface and air patrol while the convoy is within the coastal zone. The orders for sailing should indicate the order of departure of vessels, the speed and the formation to be taken after clearing the channel.

The Voyage.—During the voyage there is little to be accomplished jointly, except in making detailed plans for disembarkation.

The troops and animals should be given daily exercise and great effort should be made to have all compartments thoroughly ventilated.

In making plans for the landing, the naval officers detailed as boat officers should be carefully instructed in the positions they are to reach, pointing out, if possible, any peculiarities of the shore line which would be of assistance in guiding them. All data concerning tides and tidal currents should be studied with a view to determining the most favorable time for landing heavy equipment. The troops should be assigned to boats, lighters, etc., for landing, and instructed in the procedure to be followed upon landing, the plans for supplies of food and water, and the tactical objectives.

There are some questions concerning the joint operations of army and navy forces which can be answered definitely only by war-time experience. Many of these concern the most effective method of conducting the disembarkation.

A study of past operations may, however, be of some assistance in reaching a common conclusion on some points. In the next article the strategical considerations pertaining to joint operations will be discussed.

MAIN BATTERY ELEVATIONS AND FIGHTING AIRCRAFT

By Lieutenant F. P. Sherman, U. S. Navy

THE attention of both the Navy and the general public has recently been engaged by the question of gun elevation and the relative effectiveness of the treaty fleets at long ranges. It appears that alterations in the main batteries of American capital ships to permit of higher ranges being used is to be denied indefinitely and that therefore, if other conditions are equal, the American battle fleet will be at a serious disadvantage in a fleet action.

At 21,000 yards and under, the effective main battery fire of the three treaty fleets is as follows:

Firing	Britain	Japan	U. S.
Ships	20	10	18
Guns	166	96	192

At a range of 24,000 yards the effective fire of the three treaty fleets is as follows:

Firing	Britain	Japan	U. S.
Ships	20	10	10
Guns	166	96	108

At 27,000 yards the effective fire would, with the aid of flooded blisters, be about as follows:

Firing	Britain	Japan	U. S.
Ships	16	—	5
Guns	126	—	48

Not until the range drops to 21,000 yards can our six oldest 14-inch gun ships deliver effective gunfire. The range is extremely unlikely to drop to 21,000 yards in view of our inferior fleet speed and our superior gunfire at that range and below unless some factor is introduced to offset our disadvantage at longer ranges.

There are only two ways in which a protracted gun duel at un-

favorable ranges can be avoided in weather which permits fire at those ranges; one is to reduce the enemy fleet speed by the attacks of torpedo, bombing and mining craft, both aerial, surface and subsurface, to such an extent that our fleet can reduce the range at will. The other method, the one with which this discussion is concerned, is to provide air fighting strength sufficient to insure the free use of our own spotting aircraft and to prevent the effective use of enemy spotters. Thus the tables would be turned and the long ranges become most uncomfortable for the fleet which is denied aircraft spotting. If this can be done the enemy must either withdraw or come to close quarters.

Before proceeding on the assumption that our fleet is inferior at these ranges, let us examine as far as possible the spotting plane situation in the three fleets. We find that the three fleets have carriers and planes as follows:

	U. S.	Britain	Japan
Carriers (in commission)	1 (experimental)	3	1
Carriers (under construction or alteration)	2/3	3/6	2/3
Planes in commission (approx.)	120	120	170

One can readily see that the fleets with superior gun elevations are prepared to utilize them by the use of spotting aircraft. Now spotting aircraft can spot effectively only when they are protected from the attack of hostile fighting aircraft, either by protecting fighters or by the fire of their own machine guns, preferably the former since it is a rather large order for an observer to spot main battery salvos while the spotting plane is engaging in aerial combat.

The spotting plane with which the battleships and light cruisers of the United States fleet are at present equipped, the *UO-1*, is a two-place plane carrying a pilot and observer, the function of the observer being to spot and operate the radio. So far as is known the only ordnance carried is one Very's pistol. The U.S.S. *Mississippi* is equipped with two *MO-1's*, three-place observation planes which carry a pilot, an observer and a machine gunner, but, as before stated, a spotting plane which is engaged in a machine gun action with hostile aircraft will have its effectiveness as a spotting platform rather greatly impaired. The pilot, even if he has no gun with which to fire back, will be maneuvering rather

rapidly in an effort to make himself an unsteady target. If the spotting plane is equipped with machine guns the pilot will necessarily be engaged in maneuvers to develop the fire of his guns, both fixed and free.

To defend these spotting planes and to deny to the enemy fleet the advantages of aircraft spotting at the ranges which are dangerous to us, we have at present two naval fighting plane squadrons in commission. Of these two, one is equipped with *VE-7's* which were originally designed as advanced training planes but which were adapted for use as ship planes for flying off turrets and which can best be classified as combat training planes. Their low speed, low rate of climb, low service ceiling, and single fixed gun disqualify them as service fighters. The other fighting squadron is equipped with *TS* single seaters of about 130 miles an hour speed and with a service ceiling of about 14,000 feet as a landplane. These characteristics prohibit their consideration as up-to-date fleet fighters when pursuit planes making 170 miles an hour with a 27,000 foot ceiling are available.

It is very evident that the way to increase the effectiveness of the fleet in battle is to build up a force of naval fighting planes which can effectively protect its own spotters and which can interfere with enemy spotting planes to an extent which will prohibit their effective spotting at the ranges where our fleet is unable to fire. No provisions of the Washington Treaty can possibly be invoked to prevent this step and the huge sum of money which the recent decision not to elevate the guns of our battleships has retained in the treasury would provide a force of fighting aircraft without a peer. Incidentally, the same fighting aircraft, by securing control of the air, would greatly facilitate the reduction of enemy fleet speed and effective strength by torpedo and bombing aircraft, as well as assist in the tasks of tactical scouting. They would also be of great value in assisting in the air defense of a fleet lying at anchor, moored in crowded harbors, or passing through the Panama Canal.

The general battle mission of fleet fighters is to secure and maintain control of the air in the vicinity of a fleet action; or, to phrase it differently, to destroy such enemy aircraft as threaten the security of their own surface and air craft. Under this general mission they have the following specific missions.

1. Protection of capital ships and carriers against air attack.
2. Protection of torpedo and bombing planes against enemy fighters.
3. Protection of spotting planes.
4. Attack on enemy spotters.

The relative importance of the first two missions depends on the progress of the battle, the tactical situation, and on just when the opposing fleets launch their torpedo and bombing plane offensives. The relative importance of the last two missions depends on the main battery gun range and the number of ships delivering effective fire. When the range is between 21,000 and 31,000 yards attacking enemy spotters is, to our fleet fighters, supremely important.

Consequently, the whole subject of gun ranges of capital ships in their own and enemy fleets in their relation to aircraft tactics might well be the subject of study and indoctrination in fleet fighting squadrons. The importance of proper operation of fleet fighters with reference to capital ship characteristics, gun ranges and speeds, and the necessity for a rapid and accurate analysis of the surface tactical situation in deciding on the relative importance of the various lines of endeavor which present themselves, bring out very clearly the absolute necessity for fleet fighting units to be manned and led by seagoing naval officers. It is to be feared that a "separate air force" or army pursuit pilot would have difficulty in recognizing ships engaged, ranges in use, and in analyzing the situation with reference to main battery gunfire.

A CELESTIAL CRUISE

By Lieutenant H. V. Wiley, U.S.N.

DURING the week of January 24, 1925, preparations were make at the Naval Air Station, Lakehurst, New Jersey, to carry a party of observers in the U.S.S. *Los Angeles* to observe the solar eclipse due on Saturday morning. It was intended to make a rehearsal flight with the observers, and for this reason the party arrived early in the week and installed their gear.

Observing parties in charge of Captain Pollock, U.S.N., of the Naval Observatory, assisted by an equal number from the ship's crew, were detailed to stations, which consisted of two double, long focus astronomical cameras located in the passenger car; a spectrograph for photographing the spectrum of the corona; two moving picture cameras to photograph all phases of the eclipse and the moon's shadow sweeping across the earth's surface; officers to sketch the corona; lookout for comets; several "still" cameras for general work and photographing shadow bands, and navigating officers equipped with bubble sextants and the Pierce camera sextant to get the ship's position.

Calculations of lift, volume of gas, ballast, load, trim, fuel, ceiling, and so forth, were made, and the ship prepared to carry forty-two persons, with scientific equipment, fuel for thirty hours at full speed, and 800 pounds of food. Severe winter weather, including a blizzard, prevented a flight for rehearsal purposes, hence rehearsals were held with the observers at their stations with the ship in the hangar.

Forecasts of Thursday indicated that the airship could be taken out of the hangar on Friday morning, and moored at the mooring mast until time for departure, but the winds did not follow the forecasts. All day Friday the handling lines were kept attached to the ship; the engines were run intermittently to keep them warm and the ship was kept in readiness to go out at a moment's notice if the wind abated. The forecast was favorable for undocking

U. S. S. "Los Angeles" at Mooring Mast
Note brow for entrance to keel passageway

after 5:30 P. M. However, the wind maintained a velocity of fifteen to twenty-eight miles per hour through the night.

The flying crew, observing party, and ground crew were ready for instant call. As it was planned to make the observations in the vicinity of Nantucket light ship, it was necessary to sail by 3:00 A. M., but at this time the wind was still averaging about fourteen miles per hour, with gusts to twenty-two. About 3:30 A. M. a lull occurred, during which the wind dropped to an average of ten miles, and at 3:45 the ground crew was called. The temperature was 4° F. and the flying crew appeared in fur-lined flying suits, helmets and boots, while the 300 men of the ground crew wore woolen blanket shirts with windproof suits, wool-lined canvas gloves, and knee-length rubber arctics.

At the time of walking the ship out of the hangar, the wind was about eight miles per hour forty-five degrees from the axis of the hangar. The ship dropped ballast until in equilibrium, and was walked out of the lee door stern first, the ground crew being divided into thirteen groups, eight of which were on the windward side, four on the leeward, and one on the center line at the bow. Each group held a line attached to a ship's frame by a pendant, the handling part of which was formed of a "spider" of fifteen lines, with toggles for getting a good hold on the line. In addition, the handrails of the centerline cars were manned with about seventy-five men.

After clearing the hangar, a gust started the ship broadside, and it was necessary to walk the ship, with the assistance of her engines, to leeward to get away from the hangar. After "weighing off" on the field, and adjusting ballast until the ship was in trim and slightly light, she was allowed to rise and the engines started. Because of extremely low temperature, it was decided not to use the water-recovery apparatus, as the exhaust gases from the engines would not give enough heat to keep the condensed water from freezing.

Due to the late start, it was decided to make the solar observations in the vicinity of Block Island. At sunrise, the ship was above the clouds near the south shore of Long Island, and the beautiful sunrise seemed to portend some of the divine picture soon to be seen. Upon approaching Montauk Point, an altitude of 5,000 feet was reached. The lowered atmospheric pressure at this height

allowed the gas bags to expand until they almost completely filled the mammoth envelope and bulged against the net of cotton lines which is rigged around the interior of the rigid frame. Five hundred feet higher and the automatic valves would open. Clouds were above toward the land, and below, to seaward. At 0840 the vessel was about twenty miles south of the path of the center of totality, headed on a course normal to the sun's bearing, so that the instruments mounted on the starboard side of the ship would be pointed to the sun. An airspeed of thirty-eight knots and altitude of 4,500 feet were maintained. This brought the ship to the center of the path of totality at the time of totality.

To the northward could be seen Long Island and the Sound, the mainland, the Thames River at New London, Connecticut, and Narragansett Bay. To the southward, 2,000 feet lower than the airship, was a horizon of clouds, the bank of which extended nearly to the land. In both directions all hands were viewing a never-to-be-forgotten sight, for as the crescent of the sun became smaller and the awesome gloom deepened, both to the northward and southward majestic panoramas of gorgeous, rapidly-changing colors were unfolded. The water surface, and the contrasting shades of the water and snow-covered land of Block Island and the mainland afforded a constantly changing kaleidoscope of beautiful colors, which defy description in mere words. Near the sun, a dense blue-black sky. Farther to southward, a hazy cloud. The sun viewed through smoked film was a small crescent of silver.

The men at altitude and direction controls were cautioned to keep the ship ready. Darkness deepened. The moment of totality approached. The light of the sun could soon be endured by the naked eye. Little dots around the edge, Bailey's Beads, were all that were visible. Observers exclaimed at the beauty of the scene.

Then, out of the northwest, appeared a vast shadow slipping over the earth's surface at incredible speed. Picture if you can, a summer thunderstorm which blackens a distant area of the sky, and as it approaches, appears very threatening. The whole sky grows darker as the storm develops. The firmament takes on an ominous aspect. This scene fills you with awe. Suppose that, instead of the usual hour for the storm to develop and approach, all this happened in three seconds. Then you have an idea of how

this shadow appeared over the great relief map of southern Connecticut and Long Island Sound and swept across the airship.

The land and water changed color rapidly. Gorgeous purples, blues and yellows predominated. The clouds below to southward looked like dirty snow drifts. The compass light and luminous dials of the altitude control instruments glowed. Stars appeared in the vicinity of the sun, which had disappeared, and the moon was seen as a coal-black disk surrounded by the much discussed but unimpressive corona of pale light. Corona sketchers were working busily. An officer was counting time for the observers, in seconds. Observers were clicking their cameras, moving picture operators grinding out film. Silence!

Then a beam of light appeared at the side of the black disk. The gigantic shadow was seen traveling away from the ship toward the southeast. Darkness faded. Sighs of ecstasy came from the observers. The stars disappeared. The crescent of the sun grew larger. Again the marvelous changing colors over land and water and clouds. Observers were continuing their observations, but the previous feeling of tension and suppressed excitement was lacking.

Ten minutes more and the observers completed their work. The ship's course was changed and she took a downward inclination to seek lower altitudes. As the temperature was now twelve degrees, men were sent out on top of the little engine cars to connect the exhaust pipes to the water-recovery apparatus. The error of the chronometers was obtained from special time signals received by radio. The navigators reported the ship's position, and a course was laid for Lakehurst.

Smoke flares were dropped in order to calculate the angle of drift. The fruit and sandwiches, now frozen, and hot coffee, were called for. Relaxation at last, and elation from the view of the celestial spectacle!

At 2:20 P. M. the landing field was reached. Messages from the meteorological officer at Lakehurst stressed the importance of haste if the ship were to go into the hangar. An area of low barometric pressure was approaching, which would make conditions unfavorable for remaining at the mooring mast.

Two attempts at landing failed, because so much fuel had been used that the ship was very light, and could not be driven down.

It was necessary to pull the control wires of the valves in the gas bags and permit helium to escape. At 3:40 P. M. the ship was landed. The ground wind had a velocity of from sixteen to twenty-two miles directly across the hangar. Lines were attached, and the ship was walked up near the hangar door. The civilian force was called from work and extra lines and handling frames were attached to the ship. The ground crew waited. The flags on the hangar were restless and undecided in their movements. The meteorological officer reported that the wind had dropped to ten miles per hour. A quick calculation showed that 330 men could hold the immense sail area of the ship up to the wind. The shrill whistle of the shore pilot sounded, followed by the command, "Walk in!" Slowly the giant bulk was hauled broadside to the wind, and steadily she moved toward the hangar door. Silent discipline prevailed in the ground crew. Sharp orders were barked by officers in charge of various groups. The car parties strained to hold the ship up as she bore down upon them under the immense side pressure. The bow entered the hangar. Half of the men of the forward groups ran aft to reinforce those on the after lines; steadily the ship moved along. At last she was in the hangar and the great 1,400 ton doors began to close. The ship was moved to docking position and the crew disembarked. Quickly she was ballasted and secured.

A cheer from the ground crew rang out as the flying crew rushed to their lockers to take off their cumbersome suits, and the eventful day was a never-to-be-forgotten memory.

DISCUSSION

Proposed Administrative Changes in Navy Department

(See page 357, March, 1925, PROCEEDINGS)

CAPTAIN D. V. CHADWICK, (SC), U. S. NAVY.—I am in hearty accord with all that Commander Fisher has said and proposed in this article. I desire to state, also, lest this statement may have the appearance of a too hasty acceptance of the ideas set forth, that I quite independently had long since arrived at the conclusion and am of record to the effect that our troubles in accounting were due to faulty organization.

Commander Fisher has done some straight thinking as well as frank speaking. By an orderly array of facts he proves beyond peradventure of doubt that the chain of administrative control from Congress to the Navy Department to the bureaus to the yards and ships is broken; that authority and responsibility are divided; that the old parallelism in organization which existed between the yards and the Department, and fleet and the Department, is gone. This being granted, it must be apparent that no addition of non-statutory offices, no number of boards and no elaboration of accounting can restore this parallelism. No matter how good the motors they won't operate efficiently if they receive direct current when they are wound for alternating current. Meters won't register if the system is full of grounds and short circuits, yet fifteen years ago we changed our navy yard organization to an alternating current system and continued to operate a direct current power plant.

Commander Fisher suggests a remedy—the only remedy, since it seems to be agreed that our navy yards and fleet are organized along modern and economic lines—that is, a reorganization of the Navy Department. In his plan of reorganization he hews straight to the principle that authority and responsibility go hand in hand and defines the limitation of each new bureau by clean-cut, geographical lines which are in marked contrast to the nebulous, arbitrary, expanding and contracting boundaries of the present He would bring about in practice that much desired millenium of the navy accountant, only one appropriation to be dealt with by the individual disbursing and accounting officers, and would do away with the necessity for suspense accounts. He renders it possible to create a true cost system where all elements of cost in their proper proportion may be taken into consideration unentangled with current cash expenditures.

In short, by a system of organization sound in principle, he brings about a simplification in accounting and cost-keeping so far-reaching that it is impossible to estimate its economies. I feel convinced that to value the practical benefits of the present accounting system at twenty-five per cent of

its cost would be liberal. Since this cost should include all of those, both civil and military, ashore and afloat, directly or indirectly concerned with accounting, it is a huge sum. If it could be ascertained it would be a figure larger than any stated figure of record. The saving in what is now misdirected effort would be proportionately large.

However, Commander Fisher's remedy is an exemplification of the oft quoted proverb, "You can't make an omelette without breaking eggs." Neither can you reorganize without making changes. At present, the staff corps of the Navy are each represented by a bureau of the Department. It is on the accomplishments of their respective bureaus that staff officers feel that their prestige as staff officers rests. It is to their own bureaus that they look to guard their individual and corps rights and interests. Commander Fisher's plan of organization, with but a single exception, subtracts from each staff corps bureau. The issue raised is plain.

Since it is only human nature to view any change in the light of its effect on the individual and since the individual may feel that his interests are jeopardized for the reason above mentioned, opposition may be expected.

Can a plan, sound in theory and promising in the hope held out for relief from what is fast becoming an intolerable situation, be kept from official recognition by selfish motives? My hope is that this paper will receive the recognition from the Department which it merits, because of its carefully thought out detail, sound principle and honesty of purpose.

Basic Education of Officers

(See page 274, February, 1925, PROCEEDINGS)

BROCKHOLST LIVINGSTON.—Ensign Folk may be "ratey" but he was called to the attention of the readers of his article, the fact that somewhere there is a deficiency in the training of men to be officers of the United States Navy. He does not offer to locate, definitely, that lack but he sets forth a "panacea."

The present writer will not venture to question many of Ensign Folk's statements but he will undertake to discuss briefly a part of his, on the whole, most interesting and needful article.

Aristippus, the philosopher, being asked what were the most necessary things for well-born boys to learn, said, "Those things which they will put into practice when they become men." Will a midshipman or an officer of the Navy use Latin and Greek in his later life? Many could now say as Fontaine did: "Let ignorance talk as it will; learning has its value." Yes, learning has its value. No study and knowledge is wasted but in the few short years which we mortals live upon this universe, our time is so crowded that we must undertake only those things which we shall "put into practice when men," and it is for this reason that Latin and Greek, although developing the mind and culture of the naval officer, could be well supplanted with a technical study. Ensign Folk admits that the time of preparation for the great after work is crowded and yet he wishes to utilize valuable time for

the study of classics. Would it not be better to use this time in preparing our future officers for their work? Our venerable Mahan believed in history as a basis for study. Can we not find in history the foundation for our strategy, our law and even our very civilization? Why not, then, use such time as would be devoted to the classics in the perusal of records of former ages? It is doubtful if the cultural training afforded by history is exceeded, even by the classical languages.

In the matter of the study of Spanish and French, one cannot but praise the attempt to increase the knowledge of these languages among the officers of the Navy. There is a slight understanding of these two tongues but the study should be extended so that every ship may have, at least, some officers who are fluently versed in these foreign languages.

The midshipman who, upon entering the Academy, has had the benefit of training in seamanship and in the spirit of the Navy, will have the advantage over the young man without that knowledge. Ensign Folk advises a junior or preparatory naval academy where boys would receive this training in fundamentals. Until the advent of that school, would it not be wise to stress in every possible way, the entrance to the Academy of the allowed number of enlisted men? These men know the Navy. They understand the standard which is required. In short, they reflect, by their entrance, the spirit of the service.

At the present moment there is one question among many which is causing great concern to the authorities. That perplexity is the number of resignations among the officer personnel of the Navy. "Unrest," says Ensign Folk, "impairs efficiency." This is true. He then adds: "Somewhere along the way in the training of officers there has been failure in the matter of instilling in their hearts a true love of service." This is offered by him as an excuse for the resignations and unrest. Does he, or do the "powers-that-be," realize the seriousness of an ailment which threatens to shrink the Navy to the danger point? Ensign Folk has written his article. It has appeared in print. Shall the matter rest here? Cannot something be done to remedy this failure which impairs the efficiency and dangers the naval establishment?

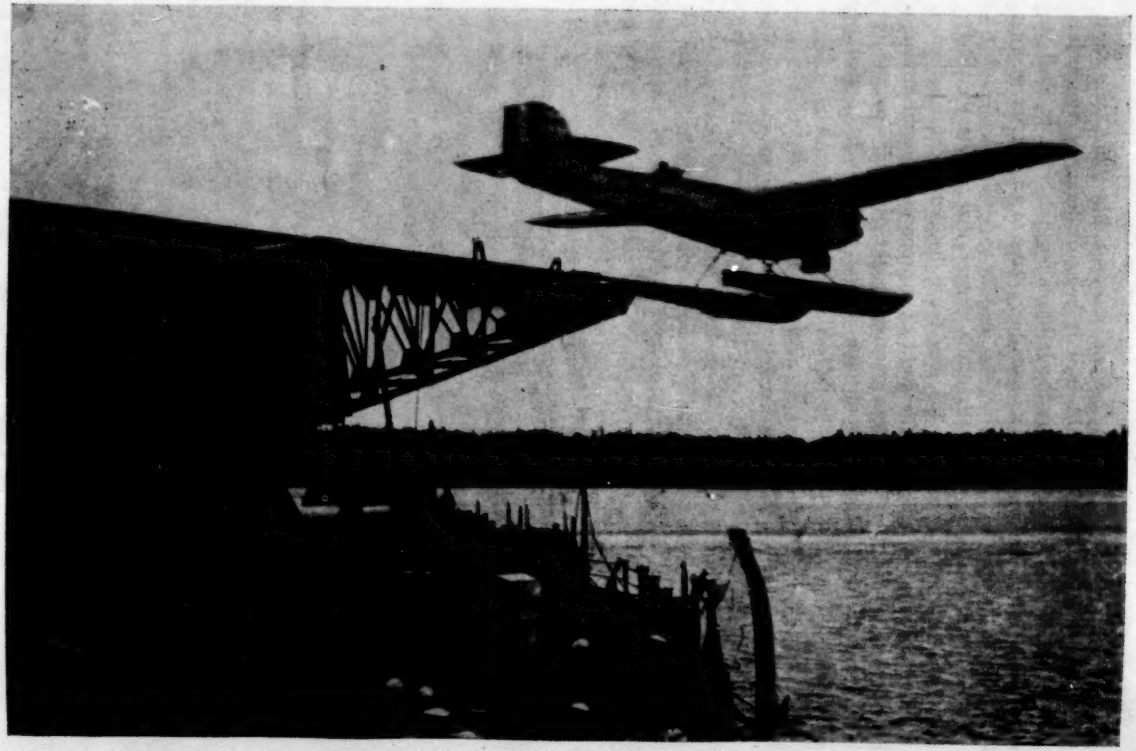
At this point it may be wise to question the advisability of accepting a certificate in lieu of the ordinary written examination for entrance to the Academy. Has this plan proven satisfactory? Could it be that this has something to do wtih the entrance of men who leave the service after a short period? Is not the examination a test, aside from that in which to gauge the person's knowledge of such and such a subject? It is a test to ascertain one's capability of understanding something. It is an examination not alone in knowledge but in composure and equanimity.

A certain class of men have, in recent years, been among those entering the Naval Academy. It is a type not seen before by the "granite-grey Mother of the Severn side." These men lack that love of service which is an absolute necessity for any naval officer. They seem to enter the service only in order to await a good opportunity to get out into civil life.

This is the unrest which impairs efficiency. No man can have his soul in his work while he awaits a chance to leave that work to go to something new.

There is unrest and there is discouragement in the naval service. The officers who have their souls in their work are opposed by those "who await their chance." The morale of the men is being undermined and unless something radical is done to rectify the failure along the way, we shall see the Navy rapidly dwindling from its once high plane to an inferior position among the sea forces of the world.

Ensign Folk has seen and realized the danger that awaits the Navy. It is now for others to support his plea for a betterment of conditions. Whether that support will take the form of a preparatory naval academy must be decided by others having a greater insight of conditions and requirements, but that there is something wrong can not be denied or questioned. Facts speak for themselves.



GLENN MARTIN OBSERVATION PLANE LAUNCHED BY EXPLOSIVE CATAPULT FROM U.S.S. "MISSISSIPPI"

GLENN MARTIN OBSERVATION PLANE LAUNCHED BY EXPLOSIVE CATAPULT FROM U.S.S. "MISSISSIPPI"

PROFESSIONAL NOTES

PREPARED BY

LIEUTENANT COMMANDER H. B. HIRD, U. S. NAVY

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GREAT BRITAIN

Submersible Cruisers

The Engineer, 30 January, 1925.—The submarine *X-1* arrived at Portsmouth last week from Chatham, having completed a series of trials, and will probably join the fleet before long. Her leading dimensions, as published, are as follows: Length, 350 feet; beam, twenty-nine and three-fourths feet; draught, seventeen feet; displacement, 2,780 tons on the surface, 3,600 tons submerged. Her speed appears to be high, but as the actual figure has not yet been officially announced no good purpose would be served by reproducing the unauthorized statements which have appeared on this subject. From a photograph issued to the press, the new submarine, which is the largest in the world, appears to possess several remarkable features, apart from her imposing size. She is equipped with two turrets, each containing a pair of medium-caliber guns, one turret being placed before and the other abaft the conning tower. Owing to the comparatively lofty freeboard of the vessel the guns are mounted at a height that should keep them clear of water in most conditions of weather, a circumstance which adds greatly to their military value. Hitherto, the utility of guns in submarines has been prejudiced by their low proposition, only a few feet above the water, where it is practically impossible to work them in rough weather or when the boat is steaming into a head sea. The artillery of the *X-1* is free from this defect, mounted as it is at a height but little inferior to that of the guns in the average small cruiser. Provided the turrets, the conning tower and the exposed portion of the hull are armored, the vessel ought to prove a formidable opponent to the smaller types of surface men-of-war, while against a more powerful enemy she could use her torpedo tubes, the number of which has yet to be revealed.

Control of Large Submarines

In view of the great length and enormous weight of the *X-1*, it is not to be expected that she will prove as easy to manipulate as our smaller submarines. Even the *K* and *M* boats, which are several hundred tons lighter, require very careful handling when in diving trim, and officers and crew have to be more than ordinarily proficient in their duties. In the case of *X-1*, no doubt, every mechanical contrivance necessary for the control of trim and bouyancy is installed. Both in dimensions and appearance she recalls the submersible cruisers which Professor Oswald Flamm, of Charlottenburg, claimed recently to have designed on a new principle of stability. Of his two projects, the first was for a submersible of 4,000 tons, and the second for a "diving cruiser" of more than 7,000 tons. In each case the armament was to consist of heavy guns disposed in turrets, and a great deal of protective armour was to be carried. When announcing his plans the professor took occasion to cast doubt on the skill of British submarine designers, alleging that the problem of endowing large submarines with the requisite degree of stability when in a submerged condition still baffled them, a problem which he claimed to have solved. Be this as it may, the completion of the *X-1* provides visual proof of the technical skill and enterprise of our Admiralty constructors. Another large submarine, the *V-2*, was launched for the United States Navy last month. She is 341½ feet in length, displaces 2,164 tons on the surface, and is propelled by four Diesel engines of 6,500 horsepower at a speed of 21 knots. Her armament comprises one 5-inch fifty-one-caliber gun and six 21-inch torpedo tubes. She has a complement of eighty officers and men. France, we may add, is building two submarines, *Vengeur* and *Redoubtable*, each with a submerged displacement of 3,000 tons.

British Warships to Carry Eighty Planes, Washington Hears

Washington, January 26 (Special).—Much interest has been aroused here over reports that each of the new British battleships *Rodney* and *Nelson*, now nearing completion, will carry eighty airplanes as part of their equipment. These reports are the subjects of discussion among high officials of the government and speculation among naval officers.

The question asked is, Are the *Rodney* and *Nelson* battleships or airplane carriers? Naval officers apparently are satisfied that they are battleships, since under the naval treaty any vessels of more than 10,000 tons displacement carrying guns of greater than eight-inch caliber are classified as capital ships.

Some officials, however, feel that the new British fighting ships are both battleships and airplane carriers, but concede that the British Admiralty is within the letter of the treaty in putting as many planes on them as they can carry.

The understanding is that the two battle cruisers which are being converted into airplane carriers for the American Navy will carry only about 150 planes, or less than twice the number the two British battleships are credited with being able to carry.

Apparently most naval experts are not much worried over the prospects of Britain's great superdreadnaughts carrying a large number of airplanes. This is due to the fact that American battleships have had more or less trouble in taking care of the few planes with which they are equipped. On several occasions planes on board battleships have sustained serious damage from the discharge of the big guns.

Triple Gun Turrets

Naval and Military Record, 21 January, 1925.—The reported decision of the Admiralty to adopt the triple gun turret in the case of the two capital ships now building has occasioned rather conflicting criticism in the service. There are two broad points of view from which the question may be regarded: that of the naval constructor and that of the gunnery expert. To the former the principle of reducing the number of gun mountings in a capital ship offers certain very definite advantages. Chief among these are the saving of weight and space, and a reduction in the area of "vital spots" necessitating heavy armor protection.

While the gunnery specialist concedes certain points of advantage to the three-gun, or even the four-gun turret, he also advances definite points of objection. In the former category is to be conceded the benefit of more working space for the guns' crews—an advantage which more than compensates for the increase in the crews themselves. There are fewer points of magazine exposure to the dangers of "flash" and fewer points of concentration of fire control. On the other hand, the tendency of the wing guns to "set" the turret on discharge does not make for precision of marksmanship. The ideal mounting from the gunlayer's point of view is the single weapon centered dead on the radial line. Again, the objection of the bigger target, with the possibility of putting a larger proportion of the ship's fighting power out of action, is a very real one. Undoubtedly, these reasons have influenced the Admiralty in their conservatism toward the double-gun turret, and it is probably reasonable to presume that nothing but the necessity to impose supremacy of gun power over any existing type of warship upon the displacement restriction of the Washington Treaty would have induced them to depart from their traditional policy in this respect.

Leakage of Confidential Information

Naval and Military Record, 14 January, 1925.—Consistently with their policy of not publishing any information calculated to be of use to rival sea powers, the Admiralty have thus far vouchsafed no details regarding the two capital ships under construction. The British public quite appreciates and understands this, and is content merely to know that the new battleships are to be named respectively *Nelson* and *Rodney* and that they will probably represent the full limit of the displacement permitted by the Washington Treaty: namely, 35,000 tons. But not for the first time do we find the United States giving to the world British naval information which has been officially denied to the British public. Captain Hough, of the United States Navy Intelligence Department, has presented to the Naval Committee of Congress a very much fuller and more detailed description of the new ships than anything which had appeared in this country.

The result of this has been that certain American newspapers have been able to publish all the salient features of the new British ships. It is not altogether a pleasing anomaly to find that American journals are in a position to give such information. Admittedly, it is the business of any chief of naval intelligence to learn as much as he can about what other nations are doing, but we frankly demur to a course which results in general newspaper publicity. We are entitled to wonder, seeing how much Captain Hough is able to tell the world about our new battleships, just how far the penetration of Admiralty secrecy has gone and how he got his information. It is rather a favorite pastime with New York newspapers to publish news which they perfectly well know the British Government desires to withhold. We may recall how they "featured" pictures of the sinking of the *Audacious,* and the indecent haste with which they revealed

the identity of "Mr. A." when the Foreign Office had announced a diplomatic reason for trying to conceal this.

Employment of Spies

This United States disclosure of what the British Admiralty regard as confidential information will not be rendered any more palatable by the general trend of American naval politics. The incessant comparisons with, and allegations against, the British Navy are becoming so pointed as to challenge a sense of resentment. An officer of the United States Navy recently stated that, by the expedient of flooding one of the cofferdam "bulges," our battleships could attain a list which materially increased the angle of elevation, and consequently the range, of their turret guns, and that he had this from an enlisted man who succeeded in being on board one of our Atlantic fleet ships during her battle practice. Such a candid admission of the employment of spies is a little staggering: the open parading of information gleaned by such a method amounts to giving a hostage to anything but approving criticism.

Indeed, the United States Government is apparently beginning to regard this sort of thing as not wholly desirable. Accordingly, it proposes to set up a committee to investigate the grounds for these reiterated comparisons between the British and American Navies. But even this is rather conceding official sanction to all that has been alleged regarding the Admiralty's want of faith in observing the terms of the Washington Conference. The Navy Department deprecates the public discussion by United States naval officers of "secrets," but it makes no reference to the manner in which these secrets have been obtained.

The real trouble appears to be that, whereas the British Navy has merely maintained the relative position assigned to it under the Washington Agreement, the United States fleet has failed to do so. But to inferentially blame the British Navy because the American Navy has permitted itself to lapse in the standard of comparative efficiency is nothing short of childish. Why these comparisons at all? British naval policy has no reference whatever to United States naval policy. It neither recognizes reason for, nor purpose in, any sort of rivalry. In fact, it simply minds its own business.

New Battleship Features

Since Captain Hough, U.S.N., has been telling the world what the new British battleships will be like, presumably we are at liberty to comment upon this vicarious information. From the general data which he has given, two points of distinct interest emerge. The first is the statement that the vessels will carry nine 16-inch guns, mounted in triple turrets, all situated forward; the second is the statement that their speed will only be 21 knots. Heretofore, the Admiralty has followed the principle of distributing main armament as much as possible, so as to minimize the effect of hostile gunfire upon the fighting powers of the ship. The mounting of three guns in a turret instead of two, and the concentration of these turrets upon a comparatively short section of the ship's length, means the creation of a much more vulnerable target to enemy fire. The naval gunnery experts are not likely to be enthusiastic over the new arrangement; they have always held that good shooting is more difficult with a triple than with a twin-gun turret on account of the "set" of the wing guns in the former on firing.

With regard to the question of speed, we have never been able to agree that speed is of but relatively small account in the all-round qualities of a ship-of-the-line. Mobility is the essence of present-day tactics, which differ from former tactics to the degree in which they are influenced by

modern methods. Speed alone saved the high seas fleet at Jutland. One, at least, of Sheer's battle squadrons proved to be distinctly faster than all our information had led us to expect, and Jellicoe has recorded the effect of this upon his plans. Tactics, after all, mean maneuvering, and maneuvering means mobility.

The old, cast-iron idea of the "rigid line" still prevails with a certain school. But, even so, the faster rigid line must have a manifest advantage over the slower rigid line, for submarines and destroyers are very pressing factors to reckon with in a present-day fleet action. All our 15-inch gunned capital ships are good for between 23 and 25 knots—or more. If the two new battleships are only to be good for 21 knots, their presence will impose a serious maneuvering disability upon the remainder of the fleet.

Ship-Sinking Tests Analyzed by Expert

Baltimore *Sun*, 17 February, 1925.—London, February 3.—At nine o'clock on Tuesday evening, a few miles off the Scilly Isles, the dreadnaught *Monarch* "heaved up her battered side and carried a million pounds in steel to the cod and the corpse-fed conger eel and the scour of the Channel tide."

This ship, once the pride of the navy, and the last of the twenty-four British dreadnaughts scheduled for scrapping under the Washington compact, withstood for nine hours repeated attacks by air bombs and the guns of her whilom consorts. She kept afloat so long because, as one newspaper quaintly puts it, "she had been prepared for the attack." This means, presumably, that her nomal buoyancy had been augmented by special devices. Beyond an announcement of the sinking, with the locality, duration of the firing and names of the principal ships engaged therein, no details of the *Monarch's* ordeal have been released.

In maintaining reticence on the subject the British Admiralty is only following the example set by the United States Navy Department when the battleship *Washington* was destroyed a few weeks ago. Among the secrets which every admiralty desires to keep to itself, those of important gunnery tests are foremost. To the best of my knowledge, the American authorities created a precedent—not repeated—in the case of the old ironclad *San Marcos*, which was destroyed by gunfire a few years before the World War.

On that occasion they sanctioned full publicity, the effect of every hit being described by press men. This candor was the more remarkable in that the *San Marcos* tests probably were the most important of their kind that have ever taken place, having regard to their far-reaching influence on the design of later vessels.

Reverting to the *Monarch*, we are allowed to know that she was first bombed by airplanes, then shelled by light cruisers mounting 6-inch guns, and finally sent to the bottom by salvos from the capital ships of the Atlantic fleet, including the *Hood*. According to press reports, the *coup de grace* was administered by 15-inch guns at a range of ten miles.

We do not know whether she was a fixed or a moving target. It is equally doubtful whether the initial punishment by air bombs and light-caliber shell had rendered her unseaworthy. What seems to be established beyond question is that the old veteran stood an extraordinary amount of punishment, remembering that she was designed sixteen years since and that the power of naval ordnance, to say nothing of aerial bombs, had in the interim developed enormously.

The *Monarch* was one of the original group of four super-dreadnaughts —so called because they were armed with 13.5-inch guns in place of the 12-inch cannon which had hitherto been the standard armament for all

battleships, British and foreign. Incidentally, she was one of the ships in which the foremast, carrying the gun-spotting and observation platform, was placed abaft the funnel, so that, in the words of the late Sir Percy Scott, "the unfortunate officer controlling the firing of the guns would be roasted."

This curious system was first tried in H.M.S. *Dreadnaught*, and on one occasion, said Admiral Scott, "after the lookout man had gone aloft, the ship steamed at a high speed against a head wind, so that the mast near the top of the funnel got almost red-hot. The result was that the lookout man could not come down for his meals, and it was necessary to hoist food up to him by the signal halyards, which had, luckily, not been burned through." Sir Percy predicted that ships so rigged would be useless for battle purposes unless they went into action stern first. He took the liberty of drawing the Admiralty's attention to "this amazing blunder," and "got himself very much disliked for his pains." In any case, the *Monarch* and her three sisters all had the foremast stepped in rear of the funnel, in spite of which they did some of the most effective shooting scored at the battle of Jutland.

Launched in February, 1911, the *Monarch* was a ship of 22,500 tons displacement, which rose to about 25,000 tons when she was fully loaded. With a length of 581 feet and a beam of eighty-eight and one-half feet, she was seventy-nine feet shorter and nine feet narrower than the U.S.S. *Washington*, besides being over 10,000 tons lighter. She was also armored on a different principle, for, whereas the American ship had an exceedingly stout waterline belt and massive mail on other vital parts, the armoring of the *Monarch* was compromised to give fairly good protection over a much greater area of the hull.

Between wind and water she had a strake of twelve-inch Krupp-cemented steel, above which was nine-inch and eight-inch armor as high as the upper deck. This wall of steel tapered to four inches at the bow and dwindled at the stern to a mere splinter-proof apron of two and one-half-inch armor. Four of the decks were armored, though it is impossible to say what the aggregate thickness was over such sensitive places as the machinery rooms and magazines. On the whole, however, the *Monarch* was a stiffly armored ship and the system of protection she embodied seems to have been continued with certain variations, in most of her successors.

Designed with an eye to fighting German battleships, she was built mainly to withstand the 12-inch guns with which the newest of the Kaiser's capital ships then building were known to be armed. But, thereby hangs a tale. On paper the German dreadnaughts completed up to 1914 were desperately outmatched in gunfire by their "opposite numbers" in the British Navy. Eight of them carried nothing heavier than 11-inch pieces—mere popguns, as they were called in this country—while the others had ten or a dozen 12-inch, a caliber which the British had long since discarded as too light for the work it had to do. In all paper comparisons of the two fleets in those days immense stress was laid upon the British preponderance in broadside fire.

Taking a ship like the *Monarch* and comparing her broadside of ten 13.5-inch guns with the ten 12-inch guns of the *Kronprinz, Markgraf* or *Friedrich der Grosse*, it was obvious that the British ship, at each full salvo, could hurl something like 3,500 pounds more metal than her opponent, but the test of war showed such comparisons to be illusory. At Jutland the German 12-inch and even the 11-inch guns held their own against the more ponderous British ordnance. Not only did they shoot as straight and hit as hard, but nearly every shell they drove home found its way through thick armor and, still intact, exploded with shattering force inside the ship.

This brings us to the real value of gunnery experiments against modern,

full-sized, well-armored ships, such as the *Monarch* and the *Washington*. Ordinary target practice, when the target is a square of canvas held up by a wooden framework, is useful enough as a guide to marksmanship, but it is desirable to know, not only how often we can hit the enemy, but what damage our hits are going to do to him. This was a form of battle training in which the pre-war Germany Navy led the world. In no other fleet were ship targets employed so frequently and with so much realism.

As soon as a German battleship became obsolete it was fitted out as a target and, very often, partly re-armored with plates of the latest manufacture, the hull being packed with wood and cork to keep it afloat even when holed. It was then towed out to sea and fired at with full battle charges and at the maximum range, after which a commission of experts went on board to make an exhaustive study of every hit. Sometimes whole squadrons of these target ships were fired at by the fleet steaming in battle array.

Thanks to the plentiful data thus obtained, German designers were able to plan every new ship with the absolute maximum of invulnerability possible on a given displacement. Having seen with their own eyes the effect of heavy shell on certain vital parts, they took good care to cover those parts with virtually shell-proof armor. It was directly due to these experiments that neither the engine rooms nor the magazines of German dreadnaughts could be reached by projectiles.

All this painstaking and practical research bore rich fruit at Jutland, where some of the German ships survived a hammering severe beyond words. One and all, they incorporated the sound principle laid down by Admiral von Tirpitz that "the first duty of a battleship is to keep afloat." The British who had not given much attention to experiments of the kind described, paid for their neglect by the summary destruction of several ships in which the weak spots had been overlooked.

Since those days every up-to-date navy has studied assiduously the problem of keeping ships afloat in face of attack above and below water. To this end America has sacrificed the *Washington*, Japan the still larger battleship *Tosa*, and Britain the *Monarch*, and, in consequence, the archives of each admiralty must contain priceless information on the subject of armor and subdivision *versus* shell, torpedo and bomb. So far as gunnery is concerned, the crux of the problem today is to devise a shell that will perforate thick armor without breaking up and, at the same time, carry a reliable fuse to detonate the big charge of high-explosive when the shell has found its way into the vitals of the enemy ship. The Germans had such a shell at the date of Jutland, but the British had not—some of their major-caliber projectiles are said to have been filled with ordinary gunpowder.

Admiral Jellicoe tells in his book on the grand fleet how, after the battle, British shells were vastly improved and made capable of penetrating stout armor, even at a sharp angle. But it was then too late, for the German fleet never again came out to expose itself to a target.

If we knew the truth about recent shooting tests in this country, in the United States and in Japan, we probably should find they were planned as much to try out new forms of projectiles as to give the navy gunners a chance of proving their skill. At a very cautious estimate, the effectiveness of the big naval gun, irrespective of increased caliber, has improved by 100 per cent in the last ten years; but against this must be set a marked improvement in the protection of ships.

For sinking the *Monarch* at sea instead of having her broken up and sold for junk the Admiralty has been criticized in some quarters, but there is not the least doubt that the true interests of the nation were better served by the former method. It will not be forgotten that prominent American

naval officers have declared that the technical lessons derived from the sinking of the *Washington* may, in the end, prove to be of greater value than the ship herself as a fully commissioned unit of the fleet would have been.

The Navy in 1924

Army Navy and Air Force Gazette, 3 January, 1925.—During the discussion on the Navy Estimates in March last, the late Prime Minister explained that while the policy of his government was to keep military affairs right down to the nucleus, it was also to maintain efficiency. "No rust, no laziness, and no disintegration," he declared; "brains, thought, energy, decision all the time; but an absolute nucleus, and nothing more than a nucleus." This may be said to sum up the progress of the navy in 1924, the most eventful year, in some respects, since the war. The advent of the MacDonald Ministsry in January, and the return of Mr. Baldwin to power in November, resulted in there being three first lords, three civil lords, and three parliamentary secretaries of the Admiralty during the twelve months; but the disadvantages of these changes were offset very considerably by a continuity of service among the naval members, and by the manner in which the political chiefs were guided by their professional advisers. Hence, while there was no striking development of strength, progress was consistent and continuous.

In July, King George held the first naval review since before the war, and in a message commending the fleet His Majesty referred to the conclusion of the career afloat of Admiral Sir John de Robeck, whom Admiral Sir Henry Oliver succeeded as commander-in-chief, Atlantic fleet, in August. Concurrently, a transfer took place of a large part of this fleet to Mediterranean waters, where the *Queen Elizabeth* has become a flagship. Also following the review there were exercises of the reserve fleet, which was mobilized for the first time since 1918. In the realm of fleet organization, the year has also seen an advance in the constitution of the fleet air arm, the personnel of which will be more naval in future. Also notable was the beginning of the cruiser and destroyer replacement programs, five ships and two destroyers, respectively, being laid down. Meanwhile, war programs still drag on, as, although the *Frobisher* has been finished, three other cruisers await completion, and while the last war-time destroyer, the *Whiteball*, was commissioned in August, some submarines are still outstanding.

For the extent to which the Royal Navy was seen in foreign parts, 1924 was particularly notable. The special squadron completed its world voyage in September with brilliant success, and other sections of the navy also made several visits. The Mediterranean fleet was seen in the French and Spanish ports in full force for the first time since the war, and also noteworthy was the independent cruise of submarine *K-26* from Portsmouth to Singapore and back. The increasing importance of our fleet movements in the East, and the absence of any new understanding with Japan, render the proposed improvements at Singapore essential, and the announcement in the King's speech on December 9 that the developments at this base are again to be proceeded with, after being postponed since March, was very welcome.

U. S. Naval Propaganda

Naval and Military Record, 31 January, 1925.—We make no apology for returning to the subject of United States' naval politics, because the trend of these at the present time is naturally attracting considerable attention in

this country. Indeed, if there were any real conflict of interests between the two nations it would be very easy to find something sinister in the persistent and deliberately pointed references to the British Navy. As it is, public opinion on this side of the Atlantic is scarcely stirred beyond curiosity over the blatent heroics of William Baldwin Shearer and the little band of American naval officers who are stimulating and echoing this propaganda. The declaration that, by "flooding their blisters" the latest British capital ships could outrange, and therefore inferentially sink, the latest American capital ships only causes a vague wonderment at the absurdity of discussing such a possibility.

Meanwhile, President Coolidge has definitely signified his disapproval of these tactics, and in this attitude he unquestionably carries a large body of senators with him. The statement contained in a letter sent by Captain Hugo Osterhaus, of the Naval War College, to Captain Robert Berry, commanding the New York Naval Recruiting District, to the effect that "two years ago we had an enlisted man on board one of their "Red" battleships during their (British) fleet practice" will probably attract much more attention in America than in this country. It may be true, or it may not: in either event the suggestion that the Navy Department is employing spies in the British Navy is regarded by the President as particularly indiscreet and undignified. He necessarily realizes that it is hopeless for him to press his views on the subject of a further limitation of armaments in the face of such an irritant to national opinion, but apparently there is about as much chance of stopping W. B. Shearer as there is of silencing Zinovieff.

The Washington Pact

Naval and Military Record, 31 January, 1925.—One ludicrous feature of the Shearer campaign is the outcry against the Washington Treaty. This very active propagandist publishes a letter from "a naval officer," in the course of which he says "we were sold out at Washington." A child who breaks his own toy, and points to a passer-by as the cause of it, is logical as compared with this sort of talk. America proposed the Washington Conference, she had far the most to say at the meetings, and but for the loyal support of Great Britain the idea would have fizzled in fiasco.

If the Shearer party persuade the Navy Department to violate the Washington Agreement, as they are so strenuously endeavoring to do, and thereby render it abortive, they will earn a very wide measure of commendation in this country. The idea of sacrificing the much-vaunted principle of self-determination to the dictation of a cosmopolitan convocation has never appealed to Englishmen in connection with the navy. But, apart from this, the Washington Agreement is proving ineffective in its real purpose. It merely handicaps without restraining. We could have every building slip in the country ringing with activity, and every arsenal busily manufacturing naval guns, without in any way contravening its terms.

President Coolidge hopes to see this anomaly remedied by means of a further conference upon the limitation of armaments. Mr. Shearer hopes to see it remedied by the even more simple expedient of sweeping it aside altogether. We shall see which view prevails. Meanwhile, the President is not confronted with a very promising outlook for his purpose. America prefaced her invitation to Washington by a threat that if the other powers would not dance to her tune she would build an overwhelming Navy and dominate the sea. There are a good many people who regard it as a great pity that she was not permitted to go ahead. It would have been just as good a way of squandering the British repayment as any other, and would

have led to the discovery that it takes men to dominate the sea as well as ships.

United States Sea Power

By Sir Herbert Russell, *Naval and Military Record*, 21 January, 1925.—The manifesto campaign upon the alleged inefficiency of the United States Navy in relation to the British fleet appears to be spending itself. Old Æsop taught us that the cry of "Wolf!" cannot be indefinitely maintained as a mere sham appearance of fear. From this side of the Atlantic, with a perspective of 3,000 miles across which to focus proportions, the propagandist methods of the big navy party in America have caused considerable astonishment. The average man in the street would have summed up average impression by the pertinent question as to what all the noise was about. Why has the United States apparently "got the wind up" so boisterously on the subject of the British Navy? Is it the result of a confused idea that the British Navy is preparing for *der tag* against the United States fleet? Is it jealousy? What is it? When symptoms are so very prominent it is not altogether unreasonable to inquire into the cause of them.

It would greatly facilitate to a clearer understanding of a rather mystifying trend of affairs, in which unfriendly sentiment toward this country appears to be unnecessarily in evidence, if we had some sort of knowledge regarding the official naval policy of the United States Government. Secretarial talk about a "hundred per cent Navy" and big programs of new construction and reconstruction are no clue to policy. Unless we know upon what assumption the need for a "hundred per cent Navy" exists, and to what purpose it is proposed to apply the big programs of new construction and reconstruction, we can only regard it all as the material illustration of confusion of thought. In her present-day mood of national self-sufficiency America is likely to resent any such question; to reply that it is purely her own business. To be logical in such a view she must desist from incessantly dragging the British Navy into the distorted limelight, for this has the effect of making it our business, too.

Despite all the high-pitched talk of William B. Shearer, Captain Osterhaus, and the rest of the big (drum) stick propagandists, no sane-minded person in either country is going to believe that British sea power forms the real objective of American naval policy. As far as we have been able to gather strategical purpose from indirect official utterances and from the distribution of the United States naval forces, her aim is the dominance of the Pacific. Such a vast, sketchy conception requires more concrete definition. Dominance of the Pacific may be taken to mean dominance of nearly half the world of salt water. Or it may be taken to mean the dominance of certain localized zones which would assume the utmost importance in case of the development of fairly obvious strategical conditions.

In its broadest sense, dominance of the Pacific is a doctrine aimed at presumptive rivals to the same claim. The two other great sea powers which have immense interests to defend in the Pacific are Great Britain and Japan. To the latter empire the freedom of the ocean in which she is seated is a matter of supreme moment. To Great Britain it is vital to the economic life of the empire. To the United States it is of much less imperative account than to either. Why, then, has she, apparently, made it her naval policy?

It is useless to mince matters in connection with the question which may one day involve the peace of the world. If the Pacific policy of the United States is not aimed at Japan, then it is simply inexplicable, mean-

ingless. British interests in the Pacific are definite, clear and free from any element of conflict with those of the United States. They stand, first and foremost, for the adequate defense of India, of Australia, and the swarm of other "red spots" upon that spacious map. They stand likewise for the "open door" in China. It is conceivable that this latter principle may not be wholly acceptable to Japan, but it is certainly on all fours with the policy of the United States, which regards the markets of China with a very jealous eye.

Under the Washington Treaty the relative naval strength of the United States and Japan was fixed in the ratio of 5–3. Figures of total capital-ship tonnage, caliber of guns, and so forth form a convenient standard for comparison, but a most elusive guide to any estimate of fighting efficiency. William B. Shearer appears to find immense satisfaction in reiterating that the actual relative values of the American and Japanese Navies at the present day is practically level.

The opening of the Panama Canal naturally brought to the United States a greatly increased interest in the strategical integrity of the Pacific. In war time the Canal would form a vital link of communication between the naval forces in the Pacific and in the Atlantic; therefore, the defense of it is an object of primary concern. Great Britain might conceivably menace the Atlantic entrance from her Bermuda base, but that Japan could seriously threaten the Pacific entrance across 6,000 miles of ocean is not very easy to believe.

The scheme of the winter maneuvres of the Pacific fleet perhaps affords us a better keynote to the strategical purpose of current American naval policy than anything we can find in official references to the subject. The fleet is to be based upon Honolulu and will operate against a supposititous hostile fleet which is prepared to dispute its command of the Hawaiian zone. The general idea of these maneuvres has aroused strong resentment in Japan, and very pointed criticisms of the violation of the Washington spirit which they are declared to represent have appeared in the Japanese press.

That Japan should be the objective of United States naval policy is fairly intelligible. In the age of realities war may well be the sequence to acute commercial conflict. China symbolizes the potential bone of contention. Japan wants to see the partition of China that she may satisfy her pressing need for territorial expansion by the acquisition of those provinces in which she has so steadily been following the tactics of peaceful penetration. The United States wants to see China preserved intact for the sake of the great and ever-growing market she offers.

But why drag in the British Navy as a pawn in this game? Is it a question of political camouflage? Possibly; but the thought suggests itself that, if this is so, we may presently arrive at an illustration of the old axiom about the remedy being worse than the disorder. To irritate British opinion by incessant comparisons the British Navy may conceivably prove a less wise policy than frankly letting the Japanese know what they probably pretty shrewdly guess, that it is their own fleet which forms the primary objective of American sea power.

But, as I have said, there are signs that the pother raised by a very small, very noisy minority is spending itself, although the propagandists are not likely to desist from their efforts. The attitude of the United States Government is one of increasing dissent from this sort of agitation, but it must be confessed that this appears to be less on account of any particular concern for the possible effect of it upon British opinion than from resentment at the allegations of the inefficiency of the United States Navy. In the United States Navy itself I question whether there is very

much sympathy with the methods by which it is being sought to stimulate national opinion into the demand for a "hundred per cent" fleet. I observe with satisfaction that *The Army and Navy Register* of Washington, an eminently representative organ of American service opinion, strongly depreciates the methods of what may be termed the Shearer school. In the course of an article upon "The State of the Navy," which cannot be too widely read and broadly quoted, it expresses the opinion that "there has been nothing more discreditable, as a piece of propaganda, than the publication of a letter which 'came from the (naval) war college in November,' asserting that 'the United States had an enlisted man on board the British fleet during the fleet practice, who reported on the methods by which the British increased the range of their gunfire.' "

As I have already ventured to express a similar conclusion, I naturally find particular satisfaction in this statement by *The Army and Navy Register,* not the less so because I feel that it doubtless represents the bulk of opinion in the United States Navy. The general tendency of Congress is to discourage any policy which might challenge rivalry in naval armaments. That the idea of a supreme navy has a strong popular appeal is beyond question, but, I fancy, there is a pretty general realization that too much dwelling upon the fact that the British Navy must not be permitted superiority, either imaginary or real, in any single detail may result in ultimately arousing a very undesirable spirit of competition.

What would be the effect, I wonder, upon American opinion if the process were reversed; if a large and influential section of our press were incessantly urging that the United States Navy is superior to the British Navy in this point or that (whether the allegation were true or not); and that the government must forthwith vote millions to remedy such a state of affairs? I am asking the question on this side of the Atlantic, but I would rather the answer to it came from the other side. It might bring about a sense of realization with beneficial result.

FRANCE

France and Britain to Stand Together: Plea for Quadruple Turret in Cruisers

By J. B. Gautreau, *Naval and Military Record,* 7 January 1925.—The decision of the Paris and London Governments that France and Great Britain are to stand together against both the Boche and Bolshevist perils is the only pleasant feature of the actually very gloomy political outlook. Incompetence at the head has caused France to lose most of the positions of vantage she securely occupied on January 1, 1924. "Imperialistic" France, whose generosity appears to Boche eyes stupidity and weakness, is disarming to her own peril and to that of civilized Europe. On the other hand, the twenty-six new naval units (though individually of no great moment) due to enter the service within the next six months, together with the success of new ordinance and torpedoes, encourage a wave of optimism among naval men.

The question of the quadruple turret is again on the carpet. The discarding of the 25,000-ton *Normandies,* and revelations recently made of the exceptional qualities of their armament, have caused gunnery specialists to regret that the naval service should definitely lose the substantial benefit of the studies and experiments made from 1912 to 1914, and continued for months on the morrow of the war. At first, a saving in weight, a better military utilization of the displacement, the possibility of placing twelve guns in three quadruple turrets where room could only be found for ten guns in twin turrets—such were the objects that promoters of quadruple

gunhouses had in view. But subsequent experiments brought to light other advantages, offensive as well as defensive, and even of a psychological order. The gunnery personnel can be in a ten-meters width (for the 13.4-inch caliber), under relatively comfortable conditions, three times as numerous as in an ordinary twin turret, and so placed and sheltered that, in the worst luck, the whole of the turret crew could not be simultaneously put out of action, as too often occurred in twin turrets during the war. Under direct supervision and guidance of expert officers, and having the benefit of more auxiliary appliances, gunners would feel more confident and have chances to shoot at their best and much quicker than is possible under present conditions in the most roomy twin turrets. Experiments have been conclusive, and they would be more so in real action by reason of the impression of security which the dimensions of thickness of the walls give by reason also of the better ventilation and gas fighting appliances.

Technical calculations show that a quadruple turret to contain four 8-inch weapons in pairs separated by a thick partition, while representing four fifths of the aggregated weight of the two echelon four turrets of the *Tourville* (now building), would combine thicker plates forward and on the roof (the two most vulnerable points), with better base protection, better loading arrangements, and additional structural strength (as had proved to be the case in the *Normandie*). An anti-aërial screen, designed to cause the bursting of bombs at a safe distance from the roof, would cover the whole turret; but it is especially against poisonous gases that a roomy gunhouse is necessary, fitted with up-to-date air producing and breathing appliances. Against the new forms of warfare, the greatest measure of safety for the artillery armament is to be thought either in a concentration in the smallest possible number of well-protected armored gun-positions or in the dispersal of the target by means of single guns distributed as far apart as possible behind shields as in the British *Frobishers*. Besides, against 8-inch shells only concentration of guns in quadruple turrets can provide sufficient all-round protection under plates of adequate thickness.

In the course of the recent naval debate, Deputé Sevene urged the construction of battleships to replace the lost *France* that was wrecked during night maneuvres on the Brittany coast two years since. France has the right, under the Washington Agreement, to lay down at once 35,000 tons of battleship tonnage and another 35,000 tons in 1927. The argument is that technical progress and the utilization of aerial power for battleship defense have altogether modified the aspect of the capital ship problem *tô le cuirassé devient de plus en plus invulnerable*, and call for a revision of the decision that was arrived at in 1919, when the *Normandies*, of 25,000 tons, were officially discarded on the eve of their completion. Minister Dumesnil, well aware of the importance of the problem and also of the fine work being conducted in that direction by our technical experts, cautiously answered that the time has not yet come for a final answer on that question, actual financial straits compelling France to seek safety in those defensive weapons that could be procured most quickly and economically—aerial and flotilla units. France has not given up the battleship. Should Mediterranean powers order new capital ships, France, of course would be compelled to do likewise.

The idea has been put forward that France, considering the present inferiority of her battleship force and the practical impossibility of competing with Japan or America for line of battleships, should invest the battleship tonnage allowed her under the Washington clauses in ultra-rapid battle cruisers capable of giving predominance to French cruiser divisions. A 17,000-ton *croiseur de combat* could be armored sufficiently to withstand 8-inch shells, while carrying six or eight 12-inch long-range weapons, dis-

posed for end-on fire, at a speed of 33 knots. Such ships being faster than all existing capital ships, would maintain safe communications with the French Colonial Empire. Four of them could be available by 1929, taking the place of two 35,000-ton units.

The British Admiralty decision to resume the construction of the Singapore naval base is viewed with sympathy in French political and naval circles, since events are clearly demonstrating the interdependence of the ancient Colonial Empires of Great Britain and France. Especially in the Far East Europeans stand together. From her position Indo-China may be said to serve as a shield to India, and could not change hands without the very foundations of British Asiatic power being shaken. Similarly, the Singapore naval base, from the defensive and offensive strength and radius of action with which it will be endowed, will add considerably both to the value of the actual Hong Kong outpost and of the French poorly-utilized *points d'appui* of Saigon, Bai d'along-Hiphong and Camranh. Consequently, the whole strategic problem in the Far East will be changed to the advantage of Anglo-French interests—that were being jeopardized so long as no battleship base existed in Chinese waters.

The severe verdict passed by the Toulon court-martial on the commander of the gunboat *Moqueuse* (355 tons) *reconnu coupable de la perte de son batiment* lost in Chinese waters comes as a welcome departure from past traditions. The rule has been, every time a French warship has been lost, to put the blame on faulty maps, stupid weather, and *malheureux hasard.* Manly discipline at the head, the punishment of neglect, even of bad luck, in the case of shipwrecks, are necessary if high efficiency is to be maintained and if commanders are to be worthy of that name and to feel ever on their shoulders the full weight and obligations of their official responsibilities.

Although France spent little on her aviation in 1924, much less than all other great powers, she has maintained her lead in the air, as the result mostly of the skill and enterprise of her *ingenieurs* and aviators. A new type of plane, the *avion Bernard,* realized 440 kilometers per hour; another *avion de combat* has just attained 222 kilometers per hour, with 600-pound armament and bombs on board. *Nieuport* and *Spad avions de chasse* beat last month all climbing records, while Farman's *Jabiru* and *Goliath* types proved easily first for carrying power combined with radius of action. In aerial warfare quality will decide. Potentially, France possesses most tactical assets of superiority; still, the silent, unpretentious, preserving preparation work of Bocheland remains an unknown and redoubtable factor.

GERMANY

German Naval Activity

The Engineer, 16 January, 1925.—The German Navy of today, though limited in size and consisting for the most part of obsolete material, appears to be maintained in a high state of efficiency. The active ships are frequently exercised in the Baltic and the North Sea, while no opportunity is missed of sending squadrons or single vessels to cruise in Scandinavian waters or the eastern Baltic. Every ship, before being placed in commission, undergoes a thorough refit. Most of the battleships, light cruisers and torpedo boats have been re-armed with guns of a new model, and structural alterations suggested by war experience have been made. Hitherto only three or four battleships have been kept in full commission, instead of the six permissible under the Peace Treaty, but this year it is hoped to bring the fleet up to full strength in all types. The cruiser *Nymphe* has just been recommissioned after a lengthy refit, during which the forward part of the ship was rebuilt, the original ram bow having been replaced by a graceful clipper stem. The *Berlin,* a sister ship, was similarly

altered a year or two ago. This last-named vessel sailed from Kiel in November on a cruise to the West Indies and Central America, and is thus showing the German naval ensign in foreign ports for the first time since the war. The new cruiser *Emden*, launched at Kiel on the seventh inst., was also designed with a special view to foreign service. With her center-line battery of ten 5.9-inch guns, she will be very heavily armed in proportion to her displacement. The new destroyer for which funds were appropriated last year, and which will be laid down at an early date, is reported to be of a large and powerful design.

JAPAN

Japanese Reported Building Giant Destroyers of 3,000 Tons

By H. C. Bywater, Baltimore *Sun*, 22 January, 1925.—London, January 12.—For various reasons, consequent upon the great earthquake, Japan's auxiliary naval shipbuilding program was slowed down for nearly twelve months. The commencement of some ships was delayed, others on which work had begun were suspended, and in one or two cases the hulls of half-completed vessels damaged by earth tremors and fire were dismantled and transferred to other building yards.

Now, however, conditions have become normal again and good progress is being made with the execution of the program. The cruiser *Nachi* was laid down at Kure Arsenal on November 26, following the laying of the *Myoko's* keel-plate at Yokosuka on October 25. Both ships are of the new 10,000-ton type, and it is hoped to have them in commission in thirty months. Latest reports credit them with a battery of twelve 8-inch guns.

Two further ships of the same class will be put in hand during the current year. Japan is also building four 7,100-ton cruisers, all of which should be launched this year.

I learn on excellent authority that the Tokio naval administration took advantage of the delay caused by the earthquake to redesign a number of auxiliary craft included in the building schedule, chiefly destroyers and submarines. These vessels have been modified on the basis of increased tonnage and fighting power. According to a statement issued by the minister of the navy last March 17, destroyers remain to be ordered at that date, and it is presumably to some or all of these boats that the particulars which have reached me refer.

Japan has hitherto built destroyers of 1,345 to 1,400 tons, which are heavier and more powerfully armed than the largest American destroyers, these latter averaging 1,215 tons. Against the four 4-inch guns which constitute the standard armament of all modern American destroyers the Japanese boats carry four 4.7-inch guns. Furthermore, being of the later design and construction, the Japanese destroyers are swifter and more seaworthy.

The new destroyers now building in Japan or about to be laid down represent an enormous advance over all existing boats, whether Japanese or foreign. The displacement has been raised from 1,400 tons to 3,000 tons and the armament to five 5.5-inch eighty-pounder guns.

Applied to ships of 3,000 tons the term "destroyer" is, of course, a misnomer. For all practical purposes the latest Japanese vessels masquerading under this title are light cruisers. In fact, their displacement is only 200 tons below that of the American *Denver* class of cruisers. They will have a speed equivalent to forty miles an hour, and carry enough fuel for a continuous voyage of 5,000 miles at economical gait.

They are, I understand, slightly smaller editions of the cruiser *Yubari*, a ship completed late in 1923, whose behavior both on trial and in service

is said to have given complete satisfaction. In this ship all the boiler uptakes lead into one gigantic smokestack, an arrangement resembling that proposed for the American *Indiana* class battleships, which were abolished under the Washington Treaty. The new so-called destroyers will probably have the same system of funnels.

In view of this development it will be necessary to revise all current estimates of Japanese destroyer strength based on mere numbers. In fighting power one of the new Japanese boats would be equal to two if not three American destroyers.

The super-destroyer type was originated by Germany during the World War, a number of 2,400-ton boats, each mounting four 6-inch guns, having been built for the Kaiser's navy in 1916. France has adopted this model for some of the destroyers of her new program, which displace 2,362 tons, but even these formidable units will be entirely surpassed in size, radius and gun-power by the latest Japanese design.

It is again reported that a certain number of the Japanese submarines now constructing at Kure, Yokosuka, Kobe and Sasebo will have the dimensions and armament of small cruisers, with an action of 15,000 miles. They are to be equipped with high-power oil motors, of which several sets are under construction for the Japanese Government in the shops of Sulzer Brothers, at Winterthur, Switzerland.

It is not so many years since Japan was borrowing her ideas on naval construction from the Occident and importing most of her warship material from Europe and America. Now she is setting the world's pace in novelty of design and may even be said to be outstripping all competitors in the planning of cruisers and destroyers.

UNITED STATES

American Naval Bill Discussed by Bywater

By Hector C. Bywater, Baltimore *Sun*, 20 January, 1925.—London, December 31.—It is somewhat of a paradox that naval affairs should occupy far more space in the American newspapers than in the press of this country. That the navy is Britain's "all in all," and that upon it depends, under Providence, the safety, welfare and prosperity of the realm has been for generations an article of faith with every subject of his Britannic Majesty.

You would, however, never guess as much by reading the papers here. Editors seem to have a poor opinion of the navy as a drawing card, judging from the meager space they give it. Unless something really startling occurs weeks may elapse without its being even mentioned. Once a year the leading journals publish an abstract of the naval budget, supplemented by the editorials in which the empire's need of adequate sea power is duly stressed; and almost daily the *Times* prints half a column or so of service items likely to interest naval officers, but few others.

Yet the *Times*, the *Daily Telegraph*, the *Manchester Guardian*, the *Morning Post* and other prominent organs have naval correspondents of exceptional ability, who contribute most readable and instructive stories whenever a fitting opportunity presents itself. In the main, however, the proportion of naval news in the British papers to that in the American is a four-line paragraph to a full column.

The British Navy itself does not welcome publicity as a general rule, though there have been occasions when its chiefs are only too glad to make the utmost use of advertisements. A notable case was that of Lord Fisher, than whom no naval officer ever had a higher appreciation of the press as

a means of enlisting public sympathy with his own policies in the teeth of professional opposition.

These preliminary remarks are inspired by the numerous dispatches relating to questions of naval policy and strength which have found place in *The Sun* and other American journals in recent months. The discussions in Congress on the Naval Supply Bill have been full of interest. Since in no other country is information so freely circulated by the naval authorities, and nowhere are standards of relative sea strength debated so frankly, it is curious to find Senator King urging as a reason for holding an investigation that "Congress does not have sufficient information for it to outline a comprehensive plan for the Navy or for future naval development."

My American file alone contains a mass of magazine articles and press clippings which cover every conceivable branch of naval activity, and which, properly collected, would supply all necessary data for an exhaustive study of any and every question bearing upon American naval policy, and the greater part of this material has come into my hands during the last three years.

Provision is made in the Naval Supply Bill for 86,000 enlisted men and 6,895 line and staff officers, together with 18,000 marines and 1,007 officers, a grand total of 111,902. These figures are worth looking into, having regard to statements that a man power, as in ships, the United States Navy lags far behind the British.

The inclusion of marines in the naval personnel may be objected to on the ground that their duties are chiefly of a military nature, and that they are not especially trained for service on board ship. On the other hand, they are enlisted, controlled and administered by the Navy, and would be available for duty afloat if the need arose. In fact, marines to the number of about eighty are carried in every first-line battleship, where they appear to perform much the duties as fall to the marine contingent in British ships. Further, they are employed as guards at naval ports and bases, as are the British marines. In time of war they would probably be drafted to ships of the fleet to bring the complements up to war strength, in preference to filling the gaps with seamen newly enlisted and therefore useless. On the whole, therefore, it does not seem unfair to include the Marine Corps in the personnel total for the American Navy.

The British Navy Estimates for 1924-25 provide for 100,500 officers, seamen, boys and marines and for 287 Coast Guard and marine police, a grand total of 100,787. A considerable percentage consists of boys who are not qualified either by age, physique or training to do the work of seamen. On a gross comparison, therefore, the American naval personnel is larger than the British by some 11,000.

But these figures, taken by themselves, would convey a false impression, as serious naval critics on this side are ready to admit. Where the British Navy scores is in respect of its long-service system and the resultant continuity of training, which enables the first-line fleet to be manned with a large quota of thoroughly drilled and disciplined ratings, who may be trusted to do their work with cool efficiency under all circumstances, whether in peace or war. That is an enormous advantage, which more than compensates for inferiority in numbers.

Turning to *materiel*, Secretary Wilbur's recommendation that eight cruisers be laid down in 1926 and four more in 1927 does not seem excessive. These ships, added to the ten *Omahas* already completed, would give the Navy a total of twenty-two modern cruisers, but this figure would not be reached before 1930. By that year Japan will have twenty-five corresponding vessels, only eight of which, however, approach the American

cruisers in tonnage and fighting power. But it is not only possible, but distinctly probable, that Japan also will build additional cruisers now that Great Britain and the United States have introduced new programs of such construction, and all Japanese cruisers authorized in the future are likely to be of the 10,000-ton class; so it does not follow that the building of twelve new cruisers in the next three years will place the United States ahead of Japan in ships of this type.

As Captain Dudley W. Knox, United States Navy, pointed out in his lucid article of December 15, an attempt to maintain the 5-5-3 ratio in cruiser tonnage by means of competitive building would involve the United States in extremely heavy expenditures. Secretary Wilbur estimates the cost of each 10,000-ton cruiser at sixteen and a half million dollars—the price of a first-class battleship of the pre-Jutland era. Twelve cruisers would cost $198,000,000, without counting maintenance charges, and, as we have seen, even this formidable outlay would not suffice to give the United States Navy a two fifths superiority over the Japanese.

In passing, Mr. Wilbur's estimate shows the cost of naval construction to be considerably higher in the United States than in this country, for the five 10,000-ton cruisers now building for the British Navy are tentatively priced at £2,000,000 apiece. This discrepancy in cost seems to be of recent origin, as until a few years ago the United States was building warships as cheaply as Great Britain, judging from the comparative figures then available. For instance, the cost of the United States ship *New Mexico* was returned as £2,541,000, and that of his Majesty's ship, *Royal Sovereign* as £2,680,000, though the American ship was the heavier by 6,000 tons. It may be, however, that the figures in each case were illusory, in that they did not include all items of equipment.

While President Coolidge has expressed his disapproval of anything in the nature of a shipbuilding rivalry with other powers, Mr. Wilbur very aptly reminded Congress that until an international agreement limiting so-called auxiliary construction has been signed, the only method of preserving the treaty ratio is by "a building program commensurate with that of other powers."

In view of the heavy cost of such a program, it is natural that the idea of a second naval conference should be gaining ground in the United States. But the obstacles in the way of a successful outcome are manifold and formidable. It is just as well to recognize the fact that neither Great Britain, Japan nor France is prepared to mold its naval policy to suit the convenience of American taxpayers. Nothing would be easier than to summon a new conference; nothing would be harder than to pilot it through to a fortunate issue. If the United States succeeds in doing this, her statesmen will go down to posterity as the most brilliant exponents of their craft.

Now that the dreadnaught construction is rigidly limited, the whole question of relative strength at sea pivots upon the lighter types of war vessel. These, too, might have been subject to the same system of limitation, and all the present controversies avoided, if the British proposal to abolish submarines had found support at the Washington Conference.

When this proposal was made, Britain was accused of selfishness in trying to eliminate a weapon to which she was peculiarly vulnerable. American naval experts sided with the Japanese in extolling the submarine's defensive qualities, France took the same line, and Britain found herself in a minority of one. The next development was France's claim to a much higher ration of submarine tonnage than the Hughes plan of limitation assigned to her, whereupon the British delegates refused—and with good reason—to bind their country to a narrow limit of strength in anti-sub-

marine types, which they held to include the cruiser. When, after weeks of argument, it was found impossible to compose these differences of opinion, the attempt to ration auxiliary tonnage was finally given up, since persistence in it would have wrecked the whole conference.

American public opinion, as mirrored in the press at that period, was overwhelmingly in favor of outlawing the submarine. Had this view prevailed, and the American delegates stood side by side with the British in demanding the abolition of an arm which German misuse had covered with infamy, it is at least conceivable that their united front would have overborne the opposition of other powers; and with the submarine out of the way the grading of relative strength in other auxiliary types might have become feasible, but the opportunity of November, 1921, was missed, and there is scant hope that it will ever recur.

Navy Effort to "Take" Hawaii in April to be Gigantic Affair

By Robert T. Small, Washington *Star*, 12 February, 1925.—Because of the protests voiced in the Japanese press and the wide discussions which have taken place in official circles, the American naval maneuvers of the coming spring, usually carried out in a routine, humdrum sort of way, have attracted the attention of the entire world.

They have caused inquiries to be made in the Congress and in the diplomatic corps and even the President of the United States has found it expedient to refer to the planned operations of the American fleet as carrying no suggestion or thought which might cause offense or uneasiness to any friendly power.

The story of the maneuvers is easily told. The American fleet is going to try to "take" the Hawiian Islands and is sailing out of San Francisco on April 15 on that "warlike" mission.

The islands are to be defended by the home garrisons of Army and Navy forces.

And, believe it or not, airplanes are to be used in large numbers, both by the attacking and the defending units. This ought to please General Mitchell and all the air advocates in and out of Congress.

In the coming maneuvers, however, the heavy work to be done, as usual, by the battleships. Theoretically, they are going to convoy and open the way for a fleet of transports supposed to carry a landing force of many thousands of marines. If the Navy had nothing but airplanes, they do not know how they could ever land such a fighting force on "alien" territory.

The problem before the Navy in the coming test is not only to take Hawaii, but to take it intact, as it were. In other words, the Navy must capture the naval base at Pearl Harbor, but not destroy it. The idea is that the hostile fleet must use Pearl Harbor as its own base for further possible operations.

Out of deference to the possible sensibilities of the Japanese, the maneuvers have been divested of virtually every vestige of the usual secrecy which surrounds the exercises of a military arm of the government.

While the maneuvers are among the most pretentious the Navy ever has undertaken, they are not as broad in scope as the natural problems involved would justify. For instance, the "attacking" force sallying out of San Francisco—an impossible situation from the very beginning.

Yet, if the Navy should assemble in Guam and sail from there against the Hawaiian Islands, there might be further diplomatic complications, which the Navy at all times is desirous of avoiding.

For the purposes of the war game next April the Hawaiian Islands are supposed to be cut off from all immediate assistance from the mother

mainland. The naval and military stations there will have to rely upon their own resources to repel the "enemy." To assist the regular establishments, the governor of the islands is expected to call out the National Guard and the Army and Navy reserves. To what extent the martial strength of the islands is to be mustered, the attackers are supposed to have no knowledge. The "invaders" are carrying a constructive fighting force of 42,000 marines with them and these are expected to do the trick in any land fighting which may be encountered.

The Hawaiian naval district looks rather weak on paper when it is expected to stand up against eleven burly battleships and a whole flock of destroyers, light cruisers, submarines and airplanes. The station, however, will be augmented by two submarine divisions, several mine layers and will have its own aircraft.

Sailing from San Francisco April 15, the great naval armada is supposed to reach the battle zone ten days later and is further supposed to have accomplished or failed in its purpose by May 1.

In many respects more significant than the "war game" will be the following cruise of courtesy of the American battle fleet to the Antipodes.

The Australians and New Zealanders are eager to welcome their "cousins," and the programs of entertainment are expected to be the most elaborate the officers and bluejackets of the Navy ever have encountered. A Japanese fleet recently steamed proudly about the Antipodes, and ever since that time there have been almost insistent requests for a visit by the American fleet.

The "courtesy call" upon the Antipodeans probably will be the greatest ever made by any navy. Sixty-five ships will participate. There will be ten line-of-battle ships, thirty-two destroyers, seventeen auxiliary and minor vessels and six cruisers. On the way to Australia some of the ships will stop at Pago Pago, Samoa. The ports to be visited after that are Sidney, Melbourne, Wellington and Auckland.

It is significant that at the Washington Arms Conference three years ago Australians and New Zealanders felt that their problems in the Pacific were the same as those of America. Some time after this conference, Sir Auckland Geddes, retiring Ambassador at Washington, warned the English people that British colonists in the Pacific were beginning to look more to the Americans than to the English for counsel, advice and association.

But, officially and perhaps primarily, the long cruise is for the purpose of fleet training. It is to be the longest cruise of the past four years and will carry the ships something like 13,000 miles. Far from this being a wear and tear upon machinery and personnel, Admiral Eberle, chief of naval operations, expects the ships and men to return to their stations next September in far better condition than when they start.

$30,000,000 to "Modernize" Navy Is Asked of Congress

Washington *Post*, 14 February, 1925.—Budget proposals to carry out naval construction and other work already authorized by Congress were presented to the House yesterday by Director Lord of the Budget Bureau, the request totaling $30,000,000, of which $1,000,000 would be made available at once for work on the battleship *Florida*.

Work on the *Florida* already is in progress at the Boston navy yard, and can be completed with the $1,000,000 carried in the new budget proposals. It will not be available for service with the fleet until part of the pending work is finished.

A provision of $2,000,000 is included in the budget proposal for the laying down after July 1 of the first two of the eight 10,000-ton post-

treaty cruisers already authorized and a like amount is asked for beginning construction work on six new gunboats needed chiefly in Chinese waters.

The new cruisers will cost approximately $16,500,000 when completed, and the navy general board has stated that twenty-two of these ships would be required to place the cruiser strength of the American fleet on the basis of equality contemplated by the Washington naval limitation treaty for the battleship tonnage strength of the American and British Navies.

In addition to the provision for construction of cruisers and gunboats, the budget request calls for $14,000,000 to complete the naval aircraft carriers *Saratoga* and *Lexington*, in process of conversion from battle cruisers, and $3,000,000 for procurement of additional naval aircraft. Each of the new aircraft carriers will carry seventy planes of various types and the aircraft appropriation will be for the purpose of providing these machines to be ready when the ships are commissioned.

Included in the $30,000,000 request also is a $9,000,000 item for changes and repairs on six of the older battleships, including addition of deck armor, alteration to oil burners from coal burning craft, addition of "blister" underwater protection and other improvements permissible under the terms of the Washington Treaty.

The budget as presented to Congress was approved by President Coolidge after he had been given an opportunity to examine in detail the report of the navy general board on the study it made at his request of the relative values of aircraft, battleships and submarines as naval weapons. That report is still in the President's hands, but is expected to be made public next week and add fuel to the aircraft controversy now being waged before congressional committees.

The report was submitted to the President some time ago, but is understood to have been referred by him to the budget bureau for examination in connection with appropriations to be made in the present session of Congress to carry out authorized naval construction projects.

The budget bureau referred it back to the Navy Department for suggestions on this point and the request for a considerable appropriation to carry out the projected work on old battleships is construed as confirming the expectation that the report will show the conclusion that nothing as yet known warrants abandonment of a naval defense policy based on the battleship as the essential unit of sea warfare, although the board also is expected to urge the value of naval aircraft as essential auxiliaries of the fighting fleet.

Navy Omnibus Bill Much Amended by Senate Committee

Washington *Post*, 15 February, 1925.—The Senate naval committee has reported favorably, with amendments, the Navy Omnibus Bill, which passed the House on December 10. Among the amendments made by the Senate committee are:

A proviso that any officer detailed as an assistant chief of bureau or as assistant to the judge advocate general shall receive the highest pay of his rank. This addition would increase the pay of the assistant chiefs and the bureau of yards and docks and bureau of construction and repair, and the assistant to the judge advocate general.

A provision to increase the limit of cost of three scout cruisers by $400,000 each and submarine tender No. 3 by $1,400,000.

A section providing for creation of a naval reserve officers' training corps, patterned after the R. O. T. C. of the army.

A section for the benefit of certain officers of the Navy who, while holding temporary rank, were found physically incapacitated in line of

duty and were retired in their permanent and lower rank. The amendment provides for them the retired pay authorized for the temporary rank held by them at the time of examination for retirement.

Another section provides that officers that have been retired since December 31, 1921, by reason of physical disability originating in line of duty between April 6, 1917, and March 3, 1921, while holding a higher temporary rank, shall be advanced on the retired list to, and subsequently retired in, the higher grade or rank held by them.

Another section added by the Senate committee gives the President the right to place upon the retired list, with three-fourths pay, staff officers of the Navy now on the active list who have held the permanent rank of rear admiral during the World War, after they have served ten years in that rank. The provision applies to only three officers—Rear Admiral Christian J. Peoples, supply corps; Rear Admiral Cary T. Grayson, medical corps, and Rear Admiral Frederic H. Harris, civil engineer corps.

Another added section recognizes officers of the Navy and Marine corps that have been commended especially for performance of duty in combat with the enemy during the World War, by permitting them, when retired by reason of "age ineligibility for promotion," to have the rank on the retired list of the next higher grade and three-fourths the pay they were receiving on the active list at the day of their retirement.

This would permit especially commended officers that have become ineligible for promotion by reason of age to receive three-fourths pay, instead of two and one-half per cent for each year of service under the present law, and in addition to have the rank of the next higher grade on the retired list.

Vessels of the scouting fleet based on Guantanamo Bay, Cuba, have been holding interesting spotting practice in conjunction with the aircraft observation group from Coco Solo, Canal Zone.

Night maneuvers have been conducted with targets towed by ships absolutely dark and with every light extinguished on the firing battleships. Communication was maintained by radio between the spotting planes and the ships. Because of the fact that the instrument boards of the radio sets were not visible at night, some difficulty was experienced by the radio operators.

They had to find the right wave and select out the interference with the aid of flashlights and this proved to be unsatisfactory. It was found also that an observer could not take a radio message from his ship, write it down, and keep a watch on the target at the same time. It was found best, therefore, to send short messages, which he could take and remember without removing his eyes from the target. Radio communication was found successful for night work, since it enabled the spotting planes to be kept on different levels to avoid accidents.

Some difficulties were encountered in lighting the targets. Often the splash made by the salvos was not seen at all and at other times it was difficult to tell which ship fired the shots, although each was firing at a different target. Different methods of lighting the targets were used, including searchlights, flare lights, star shells and army parachute lights.

Battleship Ahead of Plane, Naval Board Tells Coolidge

Washington *Star,* 19 February, 1925.—Opposition to a united air force, faith in supremacy of the battleship over "apparent threats against it," recognition of airplanes as an essential part of the fleet, and recommendations that the Navy be kept right up within the limits of the naval treaty are the salient features of the lengthy report submitted to President Coolidge by a special board appointed to determine the result of the development of

aviation on the development of the Navy, and made public today. The report was signed by Admiral E. W. Eberle, senior member; Major General John A. Lejeune, commandant of the Marine Corps; Rear Admiral C. S. Williams, Rear Admiral H. P. Jones, Rear Admiral Joseph Strauss, Rear Admiral A. T. Long, Rear Admiral W. W. Phelps, Rear Admiral H. H. Hough and Commander W. W. Smyth, secretary.

The board's original report was made January 17, and contained certain recommendations approximating an expenditure of $80,000,000 annually for three years, which the President felt was not warranted. A further report was requested, and from this the President has forwarded to Congress estimates for appropriations which include: Modernization of three of the six coal-burning battleships, continuation of the construction of the aircraft carriers, *Lexington* and *Saratoga;* $3,000,000 for airplanes for the carriers (which amount is in addition to the $1,000,000 for this purpose included in the budget for 1926), laying down and beginning construction of two 10,000-ton cruisers, and construction of gunboats for patrol service on the Yangtze River.

The board had recommended that the six coal-burning battleships be modernized and that seven other dreadnaughts also be modernized; that the eight 10,000-ton cruisers already authorized by Congress be built without delay; that a progressive and adequate airplane building program be authorized to insure the fleet a complete outfit, with fifty per cent replacements in reserve, as well as the necessary training planes, at a total expenditure for the first year of $20,000,000; that the three remaining fleet submarines already authorized by Congress be laid down during the fiscal year 1927 and that an aircraft carrier of about 23,000 tons be authorized and laid down without unnecessary delay.

In arriving at its conclusion, the board heard many witnesses, including the chiefs and assistant chiefs of the aeronautical services of the Army and Navy and many civilian aeronautical authorities and representatives of the aircraft industry.

A summary of the hitherto unpublished and closely guarded report on the ordnance tests of the battleship *Washington* also is included in the findings of the board.

The conclusions of the board in brief are: That sea power is necessary to the commercial life and prosperity of a nation that is engaged in overseas commerce; that the supremacy of the battleship remains over apparent threats against it; that the influence of aviation on naval warfare undoubtedly will increase in the future, but the prediction that it will assume paramount importance in sea warfare "will not be realized"; the airplane is inherently limited in performance by physical laws; the airship has some valuable characteristics, but, due to great vulnerability, is of doubtful value in war; aircraft cannot operate from territory that is not controlled by the military or naval forces of their own country; airplanes cannot occupy territory nor can they exercise control of the sea; within a distance of 250 miles from their bases or carriers airplanes may constitute a serious threat to surface ships, land forces, cities and industrial centers, for the reason that they can transport heavy bombs of 2,000 pounds in weight at present, which may reach 4,000 pounds in the future; from the result of the tests on the battleship *Washington* "it cannot be said, therefore, that air attack has rendered the battleship obsolete"; aviation has taken its place as an element of the fleet and cannot be separated from it; the separation of aviation from the Navy and its incorporation in a separate department of the government would be most injurious to the continued efficiency of the fleet in the performance of its mission; the development of commercial aviation in this country will prove of very great value to the

Army and Navy by stimulating further development of aircraft and expanding the industry; cruisers are indispensable to the fleet in war for scouting and screening, attack on enemy commerce, defense of our commerce, patrolling trade routes and participating in major engagements by operating against enemy light forces, as well as for many other duties; the destroyer is designed to use its torpedo against larger vessels and is of great value in the screen; the submarine's radius of action and surface speed have been so increased that it will be of great value in distant scouting, mine laying and offensive operations with the fleet, and finally "our national policies are all defensive and are well known to the world. Foreign powers are embarked on building programs designed to augment their fleets materially in types not limited by the treaty limiting naval armament. As long as foreign powers continue such policy the United States is forced to do likewise."

The recommendations submitted by the board on the foregoing conclusions are : "Battleships—Maintain the treaty strength; keep modernized under the treaty; apply, under the treaty, every device or change that will increase effectiveness of weapons; keep in high state of organization and training. Cruisers, destroyer leaders and destroyers—Maintain a tonnage strength based on a 5-5-3 ratio. Fleet submarines—maintain a tonnage strength based on a 5-5-3 ratio. Aircraft carriers—Maintain the strength allowed by treaty. Aircraft—Maintain in numbers, in performance and in personnel as required to insure a 5-5-3 ratio in naval air strength. Tenders and auxiliaries—Provide and maintain as required to support the combatant forces."

Detailing its discussions of a separate air force, the board says: "It is assumed by some that because the Army operates on land and the Navy operates on the sea the air force can operate independently of either. It is believed that this assumption is fallacious.

"Aircraft, a comparatively new factor in warfare, were utilized on an enormous scale and with great effectiveness in the military operations on all fronts, but were not utilized to anything like the same extent in naval warfare. Highly extravagant statements and predictions have been made on this subject. It has been predicted that the future battles of the world will be fought in the air, but at present this forecast appears fanciful."

Declaring that the maximum performance claimed for an air force would be its raids into the enemy country, the board believes it "illogical to elevate a force of such limited offensive qualities to the importance of a separate service.

"It has been claimed by certain witnesses who appeared before the board that a separate United States air force, if aided by submarines, could, by seizing bases at proper distances, carry on an offensive campaign against European or Asiatic powers," continues the report. "While respecting the professional abilities and opinions of such witnesses, the board is unable to regard such claims seriously."

Experience, says the board, has demonstrated that neither the torpedo nor the mine has been able to achieve the rôle of the principal weapon in war. "With the information now available, it is reasonably certain that the aerial bomb will also be unable to do so," it declared.

The battleship of the future, the board continues, "so far as can now be foreseen, will, at most, be a modification of the existing type." Neither aircraft nor subsurface craft alone can control sea communication and protect commerce, it is added.

Published photographs, "which show the fearful wreckage wrought by bombs dropped on battleships and which leave in the minds of the public the impression that the ship is a helpless hulk as a consequence of the bom-

bardment," says the board, are responsible for points outlined as to structure and effectiveness while damaged by explosions. "Of course," continues the report, "a bomb might destroy a turret, and that would leave us but seventy-five per cent of the main battery. The smokestacks may be shot away, with the result that the work of some of the guns would be impeded by smoke, but the boilers would function as before. The masts may be cut away, to the detriment of the fire control and communications, but we could still control the fire, less effectively, to be sure, but with a considerable degree of success. The huge structure that is built above and around the armor, and which gives us our visual impression of a battleship, can all be demolished and we still have the primary attributes for which she was designed—still in existence and still capable of continuing the battle."

The anti-aircraft gun as a means of defense comes in for praise from the board, which declares: "It has been held by many that the best defense against aircraft is other aircraft, but the board believes that in defending a battleship against air attack the anti-aircraft gun, which is always ready for use, probably holds first place, and as it improves in design and skill in use it will in the end be found quite sufficient to insure reasonable security to a ship against bombing attack."

Fault with the ability of the airplane to operate in all weather is found by the board, which cites testimony that "in the Meuse-Argonne campaign aircraft could operate less than half the time on this account," and then comments: "It will be rare, indeed, when a modern battleship is prevented by wind and sea from using her main battery guns, and she can use her anti-aircraft guns in any weather in which she can see."

In analyzing the bombing experiments of the army air service against the battleships *New Jersey* and *Virginia*, in 1923, the board says the "salient facts are as follows: Ships old and obsolete; no watertight subdivision; ideal weather; preliminary trial flights by attacking aircraft; no aircraft defense; no pumps in service; low altitude of bombers and ships at anchor." It then goes into detail about the Navy's experiments on the *Washington*.

"Strictly speaking," says the report, "the *Washington* was not a target, but a hull embodying the latest ideas of underwater construction, upon which was measured the destructive effect of both torpedo and bomb explosions by actually placing the explosive charges at such points of submergence as would test the resistance of the hull."

"After suffering the explosion of three underwater bombs of the largest size and two torpedo explosions, also of the largest size, directly against the hull, with no repair of leaks and no pumps going," continues the report, "the *Washington* remained afloat four days, and was finally sunk by fourteen hits of 14-inch shell fired at very oblique impacts to obtain data with respect to penetration of armor. The ship sunk two and three-quarter hours from the time the guns opened fire.

"For the purposes of the test the ship was ballasted to draw twenty-five and one-half feet and all watertight subdivisions were completed up to the third deck. This deck, which was about five feet above the water line, was not watertight between frames 57 and 103, a distance of 184 feet. The deck plating over both engine rooms was not in place and was only bolted down over the motor room. The third deck was open to all boiler rooms, motor rooms and machinery spaces. Air-port openings were blanked. Both main condensers were installed.

"Five bombs were exploded. Three of these contained 1,000 pounds of explosive each and were detonated under water at the most effective depths and at distances from the ship's side well within the zone surrounding the ship which had heretofore been claimed as an area in which similar explosions would destroy a ship. Two charges, each amounting to the largest

now carried by torpedoes, were detonated in contact with the hull thirteen feet below the waterline.

"The following is a summary of the report, setting forth the damage sustained by the ship after being subjected to all five explosions:

"'After test No. 1 (2,000-pound underwater bomb) the ship assumed a list to starboard of about one and one-half degrees. Outboard explosion spaces and double bottom spaces were flooded. Inner bottom was bulged, but in no place ruptured. Leaks in inner bottom could have readily been stopped by pine plugs and wedges.

"'No damage was noted above third deck. There would have been no loss of life, except possibly by men being washed overboard by water thrown on weather deck by the explosion.

"'After test No. 2 (2,000-pound underwater bomb) the damage was similar to that caused by No. 1, but less severe and less in extent; probably more damage to ship's side, but less to bottom. List increased to two and a half degrees.

"'In engine room a bulkhead casting was broken. Front brick work in boilers 5 and 7 was broken down—this brick work is not anchored. Main condensors not affected.

"'Test No. 3 (400-pound torpedo charge). During the night the list had increased. After third test list was found to be about five degrees.

"'Damage—Two outboard explosion spaces flooded and one explosion space between longitudinal torpedo bulkheads 3 and 4 also flooded. Some front brick work of boilers 2, 4, 6 and 8 came down. This probably was cumulative from other explosions. No apparent damage of third deck or above.

"'For some reason this did not appear to be a first-order explosion.

"'Test No. 4 (400-pound torpedo charge). List reduced from five to three degrees. Five torpedo explosion spaces in wake of explosion were flooded. Double bottoms between frames 80 and 97 also flooded. Slight leak in boiler room No. 8 from double bottom and from butt in outboard bulkhead where rivets had torn through. All could have been stopped by plugs and wedges and without these could readily have been handled by a bilge pump. All front brick work in boilers Nos. 4 and 6 came down. In no case did any side or back brick work come down.

"'Test No. 5 (2,000-pound underwater bomb). The most violent of the bomb tests. Ship increased her list to starboard from three to five degrees. Damage similar to that caused by No. 1, but more severe and more extensive. Inner bottom nowhere completely ruptured.

"'After all five tests members of the board were able to get to inner bottom of ship and make all inspections necessary or desired.

"'At the end of these five explosive tests, and after riding out a gale of wind for three days, the ship could have been towed to port.

"'Had a repair party, immediately after each explosion, used wooden plugs and wedges to stop minor leaks, the ship, without the use of pumps, would have remained practically on an even keel. A ship in commission would have no trouble in making port under her own steam after the five explosions.

"'There would have been few injuries and practically no loss of life except from water thrown on weather decks by the explosions.

"'Loss of oil and water, water mixing with oil and oils seeping through weeping seams and rivets would have been serious annoyances. The ship withstood satisfactorily the five explosions. Had there been time between explosions, the ship could have continued in the battle line at reduced speed. The general jar to the structure might throw gyro compasses and fire control gear out of gear, but I doubt it, if they are placed well away from the

ends of the ship. The vibration at the end of the ship from the first explosion did not put out candles nor throw them own when stuck to the deck.'

"A test of the ability of the protective decks to keep out armor-piercing missels dropped from airplanes was made. A 14-inch shell, weighing 1,440 pounds was dropped from a height of 4,000 feet point downward on the third armored deck. It failed to penetrate the deck, but the result of the impact showed that such projectiles dropped from heights quite within those attainable by airplanes would have gone through. This danger to a battleship must be met by thicker decks. It should be noted that notwithstanding the low ceiling at which the projectile was dropped, one plane made eight attempts to deliver its blow and finally dropped a bomb which missed, the other plane made three aiming flights, then dropped a bomb on the fourth and made a hit."

The World War gave an enormous impetus to aviation and it assumed an important rôle, continues the report. "The combats in the air and the daring deeds of the aces filled the imagination and there was a tendency to exaggerate the importance of air operations in bringing about the final issue of the war.

"The public imagination has been stirred by the recent flight around the world and conclusions have been drawn that are not warranted by facts. This does not detract at all from the credit due to the individual flyers. Their grit and determination in the face of hardships and at times seemingly insurmountable difficulties, and their resourcefulness in caring for and repairing their material, are deserving of the highest praise and the board desires to record its full recognition of their splendid accomplishment. However, the board cannot blind itself to the fact that no advance in the performance of aircraft was demonstrated beyond that of the *NC-4* from Newfoundland to the Azores and the Alcock-Brown flight from Newfoundland to Ireland, both made in 1919."

The board is of the opinion that a definite policy should be adopted by the Navy Department, fixing the period of service in aviation, the duties with respect to their other naval duties and the numbers employed. Aviation duty should be a part of an officer's service, as is submarine duty.

The report continues that testimony indicates the agitation for a department of aeronautics is due in a large measure to a feeling of unrest among some of the pilots in both services, and that the causes of this unrest are: Unsatisfactory promotion from their point of view; a desire to be always under the command, from the top down, of practical flying officers, and a belief that there exists a lack of sympathy for them on the part of the senior officers of both Army and Navy.

Evidence received on the subject of airships, continues the report, "shows that airships could not take any serious part in the service of supply of a fleet or station." The board is "aware that airplanes have taken off and attached themselves to airships in flight under favorable circumstances, but it is believed that this field of activity is very limited."

Navy Officers on Battleship As Two Air Bombs Explode

Washington *Post,* 25 February, 1925.—Rear Admiral Charles F. Hughes, head of the naval testing board which conducted the recent bombing experiments on the unfinished battleship *Washington* off the Virginia Capes, it became known yesterday, was stationed with a colleague on the after-deck of the ship when two of the 2,000-pound bomb explosion tests were made.

Admiral Hughes apparently did not regard this fact as worth mentioning in his report. It gave him first-hand information, however, on which to base the conclusion in that report that the only injury to personnel from the five bomb explosions conducted against the *Washington* would have been

the possibility that someone might have been washed overboard by water thrown on the ship's decks by the blast.

Describing his sensations to brother officers, Admiral Hughes said the lurch given by the hull at each explosion was about the same in his judgment as that produced in such a ship by the firing of a big gun salvo from her decks. His report shows that candles placed in the forward and after compartments of the hull, standing on the decks in their own grease and lighted, were neither extinguished nor upset by any of the five explosions.

After each explosion Admiral Hughes and other members of the test board made their way down into the hull to examine the damage done to the frames, bulkheads and other construction of the interior. They even penetrated into the double bottoms in search of information.

The two main condensers had been installed in the *Washington*, and these were minutely examined without disclosing any injuries as a result of either the bomb or torpedo explosions set off directly against the hull. Unanchored brickwork of the ship's furnaces was thrown down by the cumulative effects of the explosions, but that portion of the brickwork which had been permanently secured remained in place.

It was on the basis of this examination that the conclusion was reached that such a ship as the *Washington* would have been, if completed, could survive hits from eight torpedoes if the explosions were not bunched in one place, and that the special naval board in its report to President Coolidge, made public Wednesday, declared future battleships could be constructed so as to be secure against aerial attacks.

MERCHANT MARINE

World's Shipbuilding in 1924

The Nautical Gazette, 24 January 1925.—Launchings of merchant vessels by the shipyards of the world during 1924 aggregated more than 600,000 gross tons in excess of the total for 1923, says a statement just issued by *Lloyd's Register of Shipping*, covering the returns from all maritime countries for the past year. This represents a gain of about thirty-seven per cent over the launchings for 1923, but a decrease of about twenty-five per cent from the last pre-war year, 1913. Last year's total was 2,247,000 gross tons, as compared with 1,643,000 tons for 1923, and 3,332,000 tons for 1913. The 1924 figure, however, is the first postwar return to show a gain over the year immediately preceding it.

The 1924 gain over the previous year was due in a great measure to the increased volume of launchings in Great Britain and Ireland, as is shown in the following table, giving the comparative figures for the last two years, says *Lloyd's Register*. These represent the gross tonnage of vessels sent down the ways:

	1924	1923
United States	*139,463	172,817
Great Britain and Ireland	1,439,885	645,651
Other countries	668,403	824,713
World total	2,247,751	1,643,181

The decline in launchings in the United States brings the total for this country below the pre-war year figure, when 276,000 gross tons of merchant ships were sent down the ways here. The British total is about 500,000 tons below that for 1913, while, for the other countries, taken together, the reductions amount to about 450,000 tons.

*Including 32,536 gross tons of barges.

While in 1923 the American launchings were only 472,000 tons less than for the British yards, last year they were 1,300,000 tons less. As compared with the other maritime countries combined, however, while 650,000 tons less was launched in the United States in 1923, the 1924 total was about 525,000 tons less. This comparison emphasizes the sharp gain made by British shipbuilders last year; but it should be borne in mind that the work in British yards showed a sharp decrease in the last quarter of 1924, the total work then in hand being more than 100,000 tons less than for the other shipbuilding countries of the world combined.

Of the total shipping launched throughout the world during 1924, that which was constructed under the supervision of *Lloyd's Register* and intended for classification with that society, aggregated 1,435,435 gross tons, of which 1,187,699 tons were in Great Britain and Ireland. About eighty-three per cent of all the shipping launched in Great Britain and Ireland, therefore, was to *Lloyd's* classification, and nearly sixty-five per cent of the entire world's output. The total tonnage classed by *Lloyd's* during 1924 was more than double the figure for 1923.

While a gain was shown in the total launched during 1924, as compared with the previous year, the aggregate is less than a third of that for the record year, 1919, when 7,144,000 gross tons of vessels were sent down the ways. The comparison between production just before the war and since the Armistice, is shown by the following table of launchings for all countries, the figures representing gross tons:

	Yearly Launchings	Loss or Gain
1913	3,332,000	.....
1919	7,144,000	+3,812,000
1920	5,861,000	—1,283,000
1921	4,341,000	—1,520,000
1922	2,467,000	—1,874,000
1923	1,643,000	— 824,000
1924	2,247,000	+ 604,000

While the figures for 1923 showed the first slackening in the yearly percentage of decline since 1919, the returns for 1924 show the only gain in proportionate output since the war. Launchings for 1920 were eighteen per cent less than in 1919; in 1921 they were twenty-six per cent less than in 1920; in 1922 forty-three per cent less than in 1921, and in 1923 thirty-three per cent less than in 1922. The output for 1924, however, was thirty-seven per cent greater than that for 1923, as previously indicated.

How the launchings of American and British shipyards have compared during the various years under review is shown in the following table, giving the gross tonnages:

	United States	Great Britain and Ireland
1913	276,000	1,932,000
1919	4,075,000	1,620,000
1920	2,476,000	2,055,000
1921	1,006,000	1,538,000
1922	119,000	1,031,000
1923	172,000	645,000
1924	139,000	1,439,000

British shipyards, *Lloyd's* points out, are the only ones that show a gain in the percentage of the world's launchings as compared with the pre-war status, the comparision being with American shipbuilding and that of all

other countries combined, covering the same period just reviewed. This is shown by the following table of the division of the world's production:

	United States	Great Britain and Ireland	Others
1913	8%	58%	34%
1919	57	22	21
1920	42	35	23
1921	23	45	32
1922	5	42	53
1923	10	39	51
1924	6	64	30

In this period it will be noted the American shipbuilding industry has risen from eight per cent of the world output to fifty-seven per cent, fallen to five per cent and risen to six per cent. The British and Irish yards have dropped from fifty-eight per cent to twenty-two per cent, and risen to sixty-four per cent, while the other countries of the world fell from thirty-four per cent to twenty-one per cent, rose to fifty-three per cent, and are now back at thirty per cent.

A most significant feature of *Lloyd's* returns is the marked increase in the building of vessels fitted with internal combustion engines, launchings of this type of ships during 1924 being more than double the total for 1923, British and Irish yards launching 150,000 gross tons more than in 1923, and the shipbuilders of other countries sending down the ways 125,000 tons more than in 1923, as the following table of tonnage shows:

	1924	1923
Great Britain and Ireland	237,458	87,244
Other countries	264,340	138,756
World total	501,798	226,000

These totals compare with 209,000 gross tons in 1922, and 306,000 tons in 1921.

Another decline in the launchings of vessels equipped with turbines is shown by the returns for 1924, while the gain in motorship construction, as compared with the previous year, was 275,000 tons; the total for turbined vessels shows a drop of about 20,000 tons. The contrast between the two types of vessels for the past few years is shown in the following table of tonnage launched:

	Turbines	Motorships
1921	1,195,000	306,000
1922	776,000	209,000
1923	304,000	226,000
1924	284,700	501,798

Last year, for the first time, therefore, the building of vessels equipped with internal combustion engines outstripped that of ships with turbines. In 1921 the turbined ships launched aggregated nearly 900,000 tons more than the tonnage of motor vessels; while in 1924 the internal combustion engined tonnage was about 225,000 tons more than that of the turbined.

A further, although slight, decrease in the launchings of tankers occurred last year, although there was a slight gain in this type of tonnage in the United States and Great Britain and Ireland. This, however, was

more than offset by the decrease in other countries as the following table of comparisons for the past two years shows, in gross tons:

	1924	1923
United States	16,197	9,862
Great Britain and Ireland	65,005	58,188
Other countries	34,823	58,131
World total	116,025	126,118

A sharp gain was recorded last year, however, in the launchings of the larger types of vessels, those over 10,000 gross tons, there being twenty-one of these, as against only eight in 1923. In 1922, twenty-seven such ships were launched, and in 1921, forty-seven.

Several changes in the construction ranking of the various countries are shown by *Lloyd's* returns for 1924, in comparison with those for 1923. Great Britain and Ireland still hold first place by a large margin, and Germany remains second, although she sent down the ways last year about 165,000 tons less than in 1923; the United States remains third, but France, which was fourth in 1923 is now fifth. Japan, which was fifth, is now sixth, although her launchings were slightly greater than in 1923. Italy, which was fourth in 1923, is now fifth. Japan, which was fifth, is now in her launchings. Holland has gone from seventh to eighth, and Denmark from eighth to seventh, while the British Dominions retain the ninth position. The totals for the various countries for the last two years are shown in the following table of gross tonnage launched:

	1924	1923
Great Britain and Ireland	1,439,885	645,651
Germany and Danzig	193,952	358,273
United States	139,463	172,817
Italy	82,526	66,523
France	79,685	96,644
Japan	72,757	72,475
Denmark	63,937	49,479
Holland	63,627	65,632
British Dominions	44,879	41,263
Other countries	67,040	74,424

It will be noted that Germany and Danzig, which in 1923 launched more than twenty per cent of the year's tonnage, in 1924 launched less than ten per cent. This compares with an increase in the share of British and Irish yards from less than forty per cent to over sixty per cent.

ENGINEERING

Wearing of Turbine Blades

The Nautical Gazette, 24 January, 1925.—The question of the wearing away of turbine blades under the action of steam has received the attention of turbine builders from the very beginning, but it is only since high-speed turbines have come into use that the resistance of the blading material to wear has become a problem of the first importance.

The blades can become worn as result of either corrosion or erosion, or of a combination of the two. As a rule, each assists the action of the other, the products of corrosion being removed by the action of erosion, so that fresh surfaces are laid bare to the attacks of the former.

According to the *Brown Boveri Review*, the question of blade wear must be dealt with separately in the high-pressure and low-pressure portions of the turbine.

MATERIAL		CHEMICAL COMPOSITION											Loss Due to Erosion	
Description	Heat Treatment	Cu	Zn	Ni	Mn	Fe	Cr	Si	S	P	Pb	C	Duration of Test	Loss in Weight
													Hr.	Gr.
V_2 Rustless chrome steel.		...	...	1.49	0.32	...	12.70	0.49	0.030	0.040	...	0.14	69	0.22
V_4 Stainless steel.....		...	...	0.42	0.18	...	11.30	0.22	0.090	0.030	...	0.33	69	0.17
X_1 Stainless steel.....	Heated to 825°C. and quenched in oil												68	0.04
V_1 Special nickel steel....		...	...	10.20	0.44	...	0.14	0.25	0.013	0.014	...	0.15	69	0.48
X_2 Special nickel steel....	Heated to 825° C. and quenched in oil												68	0.12
V_5 Special chrome-nickel steel.....		...	...	21.88	1.05	...	2.06	1.47	0.005	0.034	...	0.72	69	0.02
U_2 Nickel steel.....		...	...	7.01	0.27	...	...	0.27	0.028	0.025	...	0.10	67½	1.04
X_3 Nickel steel.....	Heated to 825°C. and quenched in oil	...	...	5.04	0.27	...	...	0.22	0.034	0.014	...	0.12		
W_1 *Brass (drawn).....		72.60	27.06	...	...	0.15	...	...	...	...	0.1	Sn0.1	71	2.42
W_6 *Monel metal (drawn)		29.17	0.30	65.30	1.64	2.90	...	0.10	...	...	...	0.32	71	0.48

* As specimens of 10×10 cm. section could not be obtained from the material available, a number of pieces of these metals were laid together to make up the required thickness. Therefore, the results obtained are not strictly comparable with the remainder.

In the high-pressure region, the risk of corrosion taking place during operation is slight, as this blading only comes into contact with superheated steam. Erosion can also be eliminated here by using hard materials. Experience shows that, for impulse turbines, five per cent nickel steel, and, for reaction turbines, brass and similar alloys are quite satisfactory for the high-pressure blading.

In the low-pressure part, on account of the moisture in the steam, erosion takes place, which is also assisted by corrosion as described above, when the blading material is liable to corrosive action. What follows deals exclusively with the danger of erosion assisted by corrosion and occasioned by the particles of water suspended in the steam in the low-pressure region.

For low and medium speeds, a very wide choice of materials is available to the turbine builder for the low-pressure blading, the comparatively soft 72:28 brass having proved particularly suitable for this purpose. As they are not subject to rusting, brass blades frequently show no signs of wear, even after being in use more than ten years. There are also other alloys which are as effective as brass, or, in some respects, even superior. Monel metal should be especially mentioned in this connection, as its strength remains practically independent of temperature changes, and on account of its particular capacity to withstand the effects of erosion and corrosion.

If the blade speed exceeds 650 feet per second—which is now often the case, as the peripheral velocity of modern high-speed rotors frequently approaches 1,000 feet per second—and if the velocity of the steam increases correspondingly, the erosion of the blades occasionally proceeds with alarming rapidity, particularly when the steam contains a fairly high percentage of water. Under these circumstances, after running a few hours, brass blading shows bad signs of erosion, which would very soon result in complete breakdown. This wearing away does not usually occur on the front of the blades, but on the back of the inlet edge, and is most pronounced and progresses very rapidly toward the part of the blades remotest from the center. All these circumstances indicate that the erosion is attributable to the action of small particles of water suspended in the steam. This water is thrown toward the tips of the moving blades and the roots of the stationary blades under the action of centrifugal force, which explains the particularly pronounced wear in these regions. Further, during the expansion in the stationary blading, the drops of water are not fully accelerated to the velocity of the steam. The relationship between the water velocity and the steam velocity is not yet definitely known, but it has been demonstrated by numerous observations that the velocity of the water is very considerably less than that of the steam. The admission angle is so chosen, however, that the steam shall work without shock; as a result of their small absolute velocity, the drops of water strike the backs of the blades, and, with the present high peripheral speeds, rapid erosion of the material results.

Increased erosion is not only the result of higher speed, but a similar result follows the employment of high steam pressures without a corresponding increase in the exhaust pressure, as the steam enters the saturation region very quickly, and a great part of the turbine operates on wet steam. Further, the proportion of water present in the steam is much greater than under the steam conditions previously met with. Then, according to what has been said, it would be expected that the blade wear under these circumstances would be greater than before. As already established, soft blades of brass are quite unable to withstand this erosive effect, and Monel metal is not appreciably better in this respect. Therefore, these materials, which have been found so satisfactory in other cases, are quite out of the

12 specimens of 10×10 cm. section could not be obtained from the material available, a number of pieces of these metals were laid together to make up the required thickness. Therefore, the results obtained are not strictly comparable with the remainder.

question for the last rows of blades in limit turbines. Thus, turbine builders have had to turn to harder materials, among which alloy steels are of first importance.

The five per cent nickel steel much used in the superheat region has not proved satisfactory in saturated and wet steam, as its low resistance to rusting makes it liable to very rapid deterioration. On the other hand, the rustless twenty-five per cent nickel steel was rejected on account of its uncertain mechanical properties. Modern metallurgy has developed, under the name of "rustless steel" or "stainless steel," quite a number of new alloys, which, in addition to good mechanical properties, exhibit a high resistance to corrosion and erosion, and considerable chemical inertia, and it is from these steels that the turbine builder will have to choose his blading material.

There is one factor, however, which must not be overlooked: the working properties. A turbine blade is a relatively small component which must be very accurately manufactured, whether by some special process of rolling or drawing, or by machining with cutting tools. Some of the steels are thus completely ruled out on account of the great difficulty of imparting to them the desired form, although they may completely fulfill the blading specifications in every other respect.

Before applying these new alloy steels to conditions of operation more difficult than any so far encountered, fresh experience must be collected. It is out of the question, however, for turbine manufacturers to wait until such experience has been obtained in the ordinary manner; an opinion must be formed rapidly, by accelerated tests, as to the properties and probable behavior of these materials. In order to obtain some estimate of the resistance of the various materials in question, to erosion by wet steam, Brown, Boveri and Company have undertaken extensive researches.

In the case of the preliminary tests, the conditions were so chosen that even the best materials showed signs of being attacked after a few days, while, in the same period, the specimens of soft material were completely destroyed. The results of such a test naturally lead to a somewhat biased opinion regarding the relative value of the materials, and therefore it was amplified by numerous further tests of chemical and mechanical nature to which the various metals are subjected. From the collected results of all these tests taken together, a fairly good idea can be formed of the properties of the metals, which has at least a qualitative value.

The specimens to be tested were prismatic in form, the cross section being ten-mm square. These were arranged in front of a steam nozzle so that the steam jet impinged on two faces of the prism, the axis of the jet making an angle of 30° with one face and 60° with the other.

The specimens were prepared with cutting tools and were not subjected to any heat treatment except where specially mentioned. The surfaces were milled and finished on a grinder with a wheel of medium grain.

The tests were carried out with dry saturated steam at about 140 pounds per square inch gauge. This was expanded in the nozzles down to a vacuum of 25.55 inches of mercury, and the steam velocity attained was 3,600 to 4,000 feet per second.

After being accurately weighed, each specimen was subjected to the steam jet for seventy hours. They were then carefully dried and reweighed, the decrease in weight serving as a measure of the liability to erosion of the material concerned. A very much better opinion can be formed, however, by simply inspecting the specimens. In Fig. 1 a number of typical photographs of specimens after erosion are given.

The results of the test are summarized in the table on page 646. In addition to the description of the steel and the erosion loss recorded under the given conditions, the table also includes the chemical composition.

Without exception, the surfaces inclined at 30° to the axis of the jet of steam were eaten away to a greater extent than those at 60°. The 30° surfaces are therefore shown in Fig. 1. A definite explanation of this phenomenon can hardly be given, but it is possible that a microscopically thin protective layer of steam or water, tending to reduce the force of impact of the jet, forms over the blade surface when the steam strikes it more directly.

The two examples, V_4, X_1 and V_1, X_2, show how an increase in hardness imparted by heat treatment gives rise to a notable decrease in the loss due to erosion.

The usually high erosion resistance of the special chrome-nickel steel V_5 is noteworthy. This example is not to be considered as at all an exceptional result, a whole number of high-alloy steels of similar properties being known. They are all characterized by high tenacity and elasticity, and

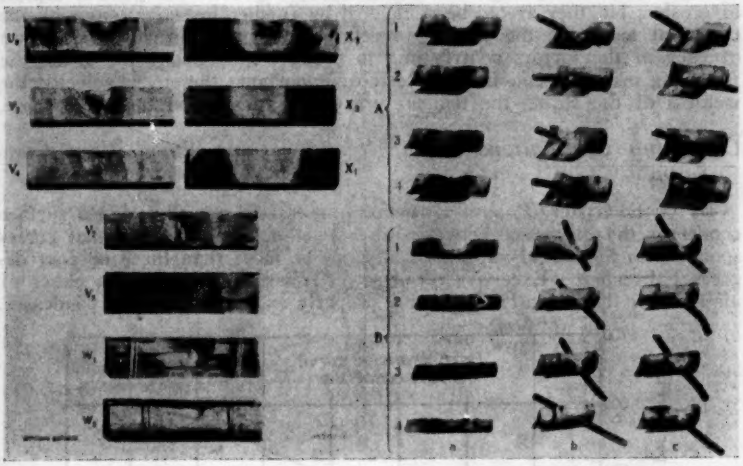


FIG. 1
RECTANGULAR SPECIMENS AFTER 70 HOURS' EROSION TEST

FIG. 2
BLADE SPECIMENS AFTER 70 HOURS' EROSION TEST

by more than average hardness. Unfortunately, they are not suitable for the manufacture of steam-turbine blades as they can only be worked with cutting tools with the very greatest difficulty. It must be left to future technical improvements to render the advantages of these steels available to the turbine builder, either by the manufacture of better tool steels than any known at present, or by the introduction of improved methods of drawing, such as will enable blades of the desired cross section to be produced directly with sufficient accuracy.

Special reference should be made to the good erosion-resisting properties of the "rustless chrome steel" and the "stainless steels" of British origin, to which it is closely related.

Th nickel steels, U_2 and X_3 do not withstand erosion particularly well, the loss suffered being very great even in the hardened state. In preliminary tests, the nickel steels hardly showed any superiority to the ordinary carbon steels. On the other hand, the favor which the former have found among turbine builders, depends upon long practical experience, the

results of which cannot be doubted. It is at least evident, however, that nickel steels are quite as unsuitable for the last stages of extremely high-speed turbines as ordinary carbon steel, a result which is fully confirmed by the most recent experience.

The very great loss of weight of the brass specimen calls for no comment. The considerable liability of Monel metal to erosion prevents its being used in many cases where it would otherwise appear particularly suitable on account of its good mechanical qualities.

As shown very clearly in Fig. 2, ordinary brass (72:28) suffered the most in these tests also, while the considerably harder manganese-nickel brass exhibited a correspondingly higher resistance. This alloy can hardly be recommended for turbine blades, however, as it is inclined to fracture from fatigue. The least erosion was suffered by the steel specimens, Monel metal being again fairly badly attacked.

These preliminary tests were only concerned with the general aspects of erosion, but they are to be completed by further investigations with the object of analyzing the process in detail and determining the importance of each of the factors contributing to produce it. Among the latter, the following may be mentioned as the most important: the steam velocity, the wetness of the steam, the temperature of the steam and the blade angle.

Operating Calculations and Instructions for Small-Plant Condensers

By G. E. Gaster, *Power*, 27 January, 1925.—In a well-designed surface condenser the difference between the hotwell temperature and that corresponding to the actual vacuum should not be more than three or four degrees Fahrenheit. Excessive terminal difference is an indication either of air leaks or that the air is not being properly extracted from the condenser.

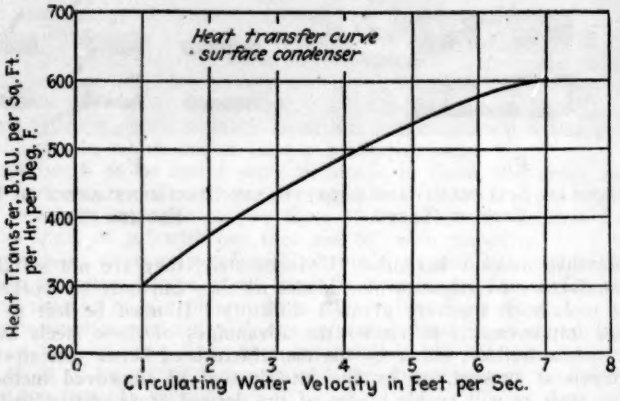


FIG. 1—HEAT TRANSFER FOR VARIOUS WATER VELOCITIES AS OBTAINED FROM TESTS

The difference between the average temperature of the cooling water and the hotwell should, for the average small plant, be about 20° F. For example, assume that the ingoing water is 60°, and the outgoing water 80°; the average then equals 70°. Therefore, the hotwell temperature should be about 70° plus 20°, or 90° F. The 20° used in the foregoing calculation is what is known as the arithmetical mean temperature difference. It is

only approximate, but is usually accurate enough for roughly checking average condenser performance.

The temperature rise of the cooling water in passing through the condenser should be about 20° F., or less. These statements are based on a velocity of six feet per second through the tubes, and a heat transfer of 500 B.t.u. per square foot per hour, per degree rise of circulating water. On the larger condensers, 5,000 square feet and up, many designers use a water velocity of seven to eight feet per second through the tubes. The B.t.u. rate of transfer varies directly as the square root of the velocity of the water through the condenser tubes. Assuming that the water velocity is six feet per second and the rate of heat transfer 500 B.t.u. per square foot per hour, per degree rise of circulating water, if the velocity of the

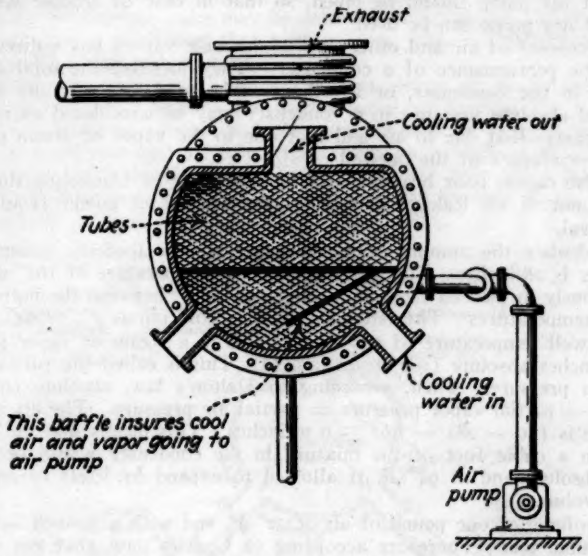


FIG. 2—DOUBLE-FLOW CONDENSER WITH BAFFLE TO INSURE COOL AIR GOING TO VACUUM PUMP

water were increased to eight feet per second, the heat transfer, per square foot, per hour, per degree rise of the circulating water, should be

$$\frac{\sqrt{8}}{\sqrt{6}} \times 500 = 577 \text{ B.t.u.}$$

The most important factors entering into surface-condenser performances are, the amount of heat-transfer surface, air leakage, air removal, temperature of cooling water, amount of cooling water, and the dirt film on tubes. Condenser manufacturers claim a heat-transfer rate of 350 to 500 B.t.u. per square foot per degree temperature difference, and heat transfers of 600 to 700 B.t.u. have been obtained on tests on large units.

The tube surface may be decreased if the amount of cooling water is increased. This will lower the first cost of the installation, but will raise the operating cost.

The rate of heat transfer in a surface condenser increases with an increase in the velocity of the circulating water through the tubes approximately as shown in Fig. 1. This curve is plotted from results secured by the writer in a number of condenser tests. The rates of heat transfer in these tests were lower than shown in curves on pages 532 and 534, Gebhardt's *Steam Power Plant Engineering*. It seems that the curves referred to are based on tests with extremely clean condensers, and with a very small partial air pressure in the condenser, and that they do not represent average operating conditions.

The interior baffling to insure air cooling in a two-pass condenser is shown in Fig. 2 and a good auxiliary layout for the average small plant, in Fig. 3. Only one air pump or ejector is ordinarily used, but an adjacent condenser air pump should be piped, so that in case of trouble with one, the other dry pump can be used.

The presence of air and other non-condensable vapors has a direct bearing on the performance of a condenser. They increase the total absolute pressure in the condenser, or in other words, tend to lower the vacuum. The total absolute pressure in a condenser may be considered as made up of two parts—that due to air and that due to the vapor or steam pressure at the temperature of the hotwell.

Air also causes poor heat transfer by insulating or blanketing the tubes. The amount of air leakage determines the amount of power required for its removal.

To calculate the amount of air leakage, assume that the vacuum in a condenser is 28 inches. This corresponds to a temperature of 101° and that as previously mentioned there is a difference of 7° between the hotwell and vacuum temperatures. The latter then equals 101° minus 7°, or 94°.

A hotwell temperature of 94° corresponds to a steam or vapor pressure of 1.61 inches absolute (see steam tables). This is called the partial vapor or steam pressure. Then, according to Dalton's law, absolute condenser pressure — partial vapor pressure = partial air pressure. The air pressure therefore is (30 — 28) — 1.61 = 0.39 inches. This means that the amount of air in a cubic foot of the mixture in the condenser would be at 0.39 inches absolute and at 94° F. if allowed to expand by itself to one cubic foot of volume.

The volume of one pound of air at 32° F. and with a 30-inch barometer is 12.3 cubic feet. Therefore according to Charles' law, that gas volumes vary in the direct ratio as the absolute temperatures and inversely as absolute pressures, the volume of one pound of air under a pressure of 0.39 inches and at a temperature of 94° is

$$\left((12.38 \times \frac{460 + 94}{460 + 33} \right) \times \frac{3}{0.39} = 1{,}072 \text{ cubic feet.}$$

Assuming that the size of the air pump is 24 × 20 and is 60 y.p.m. double acting, thus the displacement per minute is

$$\frac{\frac{(24)^2}{4} \times 3.1416 \times 20 \times 120}{1{,}738} = 624 \text{ cubic feet}$$

Assuming efficiency of 50 per cent, the pump would remove 312 cubic feet, $\frac{312}{1.072} = 0.293$ pounds of air per minute, or $0.293 \times 13.95 = 4.087$ cubic feet of free air per minute. With all steam removed, each cubic foot of

air theoretically would be at 0.39 inches absolute and 94° F. at the pump suction.

For installations where a hydraulic air pump discharges into a hurling water tank, the top of the tank may be made airtight and all the air caused to discharge through an orifice. The volume of the air passing through may be calculated by the formula,

$$Q = 0.57\, d^2\sqrt{HT}$$

where H is the difference in pressure, measured by a differential gage, in inches of water between the two sides of the orifice; T is the absolute temperature, degrees Fahrenheit, of the air discharge; d is the diameter of the orifice in inches, and Q the air discharge per minute in cubic feet.

Every possible effort should be made to reduce air leakage in a surface condenser. The larger leaks may be detected with a candle. If the leakage is greater with a small load than with a large load, it indicates that there are air leaks in the turbine casing.

Sometimes leakage occurs in the vacuum pumps or in the line to the vacuum pump. This leakage can be measured by running the pump with the valve between condenser and the pump closed. It is good practice to paint the condenser and all connections with an asphaltum paint. If the condenser is tight, the mercury column should not drop more than one to one and one-half inches in an hour, with the unit running under load and the air pump shut off, in the opinion of the author.

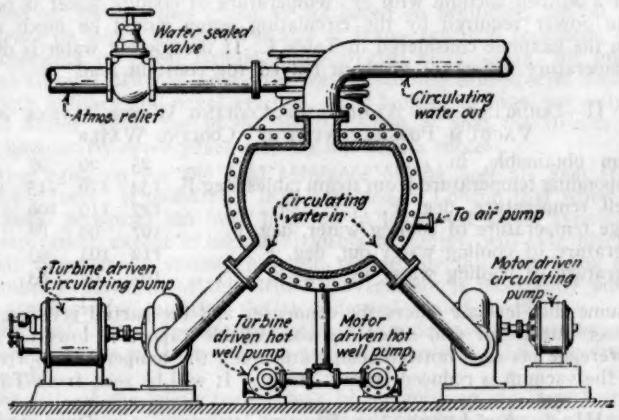


FIG. 3—BOTH A TURBINE AND A MOTOR DRIVEN PUMP ARE DESIRABLE FOR THE CONDENSATE AS WELL AS THE CIRCULATING SYSTEM

It is important that the air and vapor going to the air pump should be as cool as possible. The reason for this is that more of the water vapor will become condensed, also the volume of the air will be reduced according to Charles' law.

Assume a hotwell temperature of 95°, vacuum 28 inches, partial air pressure 0.345 inch and partial vapor pressure 1.655 inches. The gases to the vacuum pump are cooled to 62°. From the steam tables the vapor pressure will be 0.56 inch and therefore the air pressure will be 1.44 inches absolute.

$$0.345 : 1.44 = 1 : x$$

Therefore x equals 4.2, which means that we have increased the capacity of the air pump 4.2 times by cooling the air to the dry pump from 95° to 62° F.

The effect of air leakage, amount of cooling water and temperature of cooling on the performance of a surface condenser are best shown by a concrete example. Assume that owing to the presence of air and non-condensable vapors, there is a 7° temperature difference between the theoretical vacuum temperature and the temperature of the hotwell; that the amount of cooling water pumped is such as to give a 20° rise in temperature; also that the difference between the average cooling-water temperature and that of the hotwell is 20°. Table I will then show the vacuum obtainable with different cooling-water temperatures.

TABLE I—SHOWS THAT UNDER THE GIVEN CONDITIONS, 42° COOLING WATER IS REQUIRED TO OBTAIN A VACUUM OF 29 INCHES

Vacuum obtainable, in.	25	26	27	28	29
Corresponding temperature from steam tables, deg. F	134	126	115	101	79
Hotwell temperatures, deg. F.	127	119	108	94	72
Average temperature of cooling water, deg. F.	107	99	88	74	52
Temperature of cooling water out, deg. F.	117	109	98	84	62
Temperature of cooling water in, deg. F.	97	89	78	64	42

The effect of doubling the amount of cooling water, as in Table II would be that a 29-inch vacuum with 47° temperature of cooling water is possible, but the power required by the circulating pump would be much greater than in the example considered in Table I. If the cooling water is doubled, the temperature difference is about halved for constant load.

TABLE II—DOUBLING THE AMOUNT OF COOLING WATER MAKES 29-INCH VACUUM POSSIBLE WITH 47° COOLING WATER

Vacuum obtainable, in.	25	26	27	28	29
Corresponding temperature from steam tables, deg.F.	134	126	115	101	79
Hotwell temperature, deg. F.	127	119	108	94	72
Average temperature of cooling water, deg. F.	107	99	88	74	52
Temperature of cooling water out, deg. F.	112	104	93	79	57
Temperature of cooling water in, deg. F.	102	94	83	69	47

Assume that less air enters the condenser and the partial pressure in the condenser due to air and other non-condensable vapors is lowered so that the difference between hotwell temperature and the temperature corresponding to the vacuum is reduced from 7° to 3°. It will be seen from Table III

TABLE III—IF AIR LEAKS ARE REDUCED SO THAT THE DIFFERENCE BETWEEN HOTWELL TEMPERATURE AND THAT CORRESPONDING TO VACUUM IS LOWERED FROM 7° TO 3° F., A 29-INCH VACUUM CAN BE OBTAINED WITH 46° WATER IN NORMAL QUANTITY

Vacuum obtainable, in.	25	26	27	28	29
Corresponding temperature from steam tables, deg. F.	134	126	115	101	79
Temperature of hotwell, deg. F.	131	123	112	98	76
Average temperature of cooling water, deg. F.	111	103	92	78	56
Temperature of cooling water out, deg. F.	121	113	102	88	66
Temperature of cooling water in, deg. F.	101	93	82	68	46

that if the partial air pressure in the condenser is thus reduced, so that there is only 3° difference between the temperature of the hotwell and that corresponding to the vacuum, we obtain practically the same results with half the amount of cooling water that was required in the previous example.

AERONAUTICS

Report Expected to Sustain Ships

By Frederic William Wile, Washington *Star*, 15 February, 1925.—Aviation matters will be brought to a head within a few hours by the report of the Special Navy Board which will be issued at the White House. For four months the board, at President Coolidge's instigation, has been going thoroughly into every phase of the long-raging controversy over the relative value of submarines, surface warships and aircraft. The board, organized by Secretary Wilbur, has heard scores of witnesses. General Mitchell, the assistant chief of the Army Air Service, was one of them. A voluminous mass of testimony was taken and compiled. It has been in President Coolidge's hands since February 1, in the shape of a carefully prepared digest. It is this digest which presently will be made public. Its presentation is designed to contribute timely knowledge to the discussion which latterly has attained nation-wide dimensions because of General Mitchell's spectacular charges.

In Washington service quarters the prediction is freely ventured that the Special Navy Board will torpedo Mitchell's contention that American aviation cannot be properly developed except by a unified air service, and that the airplane has rendered the warship obsolete. The Army air chieftain's supporters probably will retort that no other sort of attitude could sensibly be expected from the Navy. But naval officers' hostility to a unified air service, they claim, is not based on prejudice, but on the one experience on which the world is able to frame practical judgment, namely, the experience of Great Britain. The British maintain an "air ministry," such as General Mitchell advocates for the United States, with supervision over both military and naval aviation. The bulk of opinion, not only in the United States Navy, but in the British Navy, is that the British experiment, now nearly seven years old, has not been a success.

Active agitation for the final severance of the fleet air arm from the "royal air force" is unabated. It is expected in London that when a sufficient naval personnel has been built up to take over naval aviation, complete separation, except in certain elements of supply, will take place. The anomaly of a service seventy per cent manned by the navy being directed by another department of the British Government is incessantly pointed to as an argument for restoring the air independence of the fleet.

The Royal United Service Institution at London awarded its annual gold medal prize to an essay opposing a unified air service. The winning thesis concluded:

"The pith of the whole matter may be summed up in a few words. In war there are, and always have been, two objectives—1, the enemy's towns; 2, the enemy's ships. Towns normally can only be attacked by land forces; ships by sea forces. Hence, the division throughout all history of the armed forces of nations into navies and armies.

"The air provides a third way of approach to the two original objectives, but does not provide a third objective.

"Lacking a third objective, no *raison d'etre* for a third arm exists.

"The elevation of the air force to the status of a third arm is therefore unsound, and persistence in so fundamental an error in time of peace can only lead to disaster in time of war."

France maintains separate army and navy air forces, as the United States does, and she is regarded today as the "supreme air power" in Europe. Italy has adopted a united air force, but not yet established a ministry for aviation. Opinion as to the success of the united scheme in Italy differs.

Japan has organized its growing aviation service on lines very similar to those in the United States. In December, 1920, Japan formed an air board to consider the whole problem of a future air organization. There was a group that favored patterning after the British unified system, but the scheme finally adopted was the separation of army and navy air forces. The Japanese decided that aviation at sea, in particular, is a very special business, involving such highly technical naval knowledge that it must be administered exclusively by trained sea officers. This is the view that inspires American naval opposition to a unified service.

President Coolidge hitherto has not encouraged the Mitchell idea of uniting military and naval aviation under one distinct head. As to the general utility of aviation, especially for the Navy, it is economy considerations that govern Mr. Coolidge almost exclusively. He is hostile to the unnecessary expenditure of a single dollar on old-type war craft, like surface vessels or even of submarines, if it can be demonstrated to him that aircraft, vastly less costly than surface warships, can supply as effective, or more effective, defense.

If the Special Navy Board, whose report the country is about to inspect, reflects the views known to prevail in our naval high command, it will tell the President that what America needs at sea is neither an all-surface craft Navy, nor an all-submarine Navy, nor an all-aircraft Navy. It certainly will bomb the Mitchell theory that the airplane has rendered the Navy virtually useless. It is altogether likely to report that the capital ship (battleship and battle cruiser) remains "the backbone of sea power," but that, under modern conditions, that backbone needs to be supported by commensurate fleets of submarines, airplanes, and particularly aircraft carriers. The Special Navy Board, in other words, is confidently expected to advocate a "three-plane fleet" of submarine, surface and air units, but one acting always under Navy orders and Navy officers.

Great Britain's Air Force

Naval and Military Record, 14 January, 1925.—Notwithstanding the manifestly conciliatory and concessional policy of the Air Ministry toward the Admiralty during the past year, there are definite indications that the controversy has not been finally composed by compromise. In one sense, indeed, compromise is only calculated to stiffen the attitude of the sea lords upon the whole subject, since it amounts to an inferential admission of the reasonableness of the claims which have resulted in it. The Admiralty contention is very simple and very logical. It simply demands the unfettered control of the whole of the aerial organization of the royal navy. The Air Ministry has gone a long way toward meeting this claim, but it is the one final reservation which remains the real bone of contention: the refusal to surrender administrative authority.

Even the new arrangements are quite unnecessarily cumbersome in consequence of this duality of control. In order to qualify as pilots in the fleet air arm naval officers have to be "lent" to the Royal Air Force. We do not suggest that the system may not work perfectly well, but it is simply redundant. The air arm is as much an integral part of the Navy of today as the submarine service. The new gigantic air cruisers and flying boats are intended purely for service with the fleet. As things now exist, the Air Ministry may interfere with their employment for any purpose the Admiralty considers necessary. That they would be extremely unlikely to do so does not dispose of the absurd anomaly under which they are able to do so. Duality of control has always proved a millstone around the neck of efficiency in all military organization. To deny to the navy the absolutely

unrestricted use of any of its weapons or personnel is an indefensible proposition.

The Air Ministry was one of the mushroom growths of the Great War. There was no expectation that it would survive the Great War. Ever since the Armistice it has been struggling to justify its continuance, even to the degree of usurping the functions of the Meteorological Office. Aircraft are as much part of an army as tanks, as much part of a navy as destroyers. The existent situation is simply a struggle on the part of a new bureau to survive against the sound, long-proven doctrine of the centralized control of all the component units of a fighting force.

President Opposed to Unified Air Service, Secretary Wilbur Says

Army and Navy Journal, 31 January, 1925.—In a hearing before the House Committee on Military Affairs, Secretary of Navy Wilbur stated that he was authorized to tell the committee that with the facts now before him that the President is not in favor of a united air service, as is provided for in the Curry Bill.

This is an unprecedented proceeding, according to report, and really amounts to a communication from the President to the committee. It was a profound surprise to the members of the military committee, as there had been the impression not only among its members, but throughout Congress, that the President was favorable to the Curry Bill, or a measure of that character.

Aircraft Engine Progress

Lieutenant-Commander E. E. Wilson, U. S. Navy, Head of Power Plant Section, Bureau of Aeronautics, *U. S. Air Services*, February, 1925.—In the beginning, man's ability to fly depended upon his ability to build a suitable engine. Since the beginning, continued progress in flying has hinged about continued progress in engines. To the everlasting credit of American engine builders, it must be said that they have not only met every requirement but have anticipated the demands of the designers in every way. As a result, we now have in this country dependable, proved engines in every power from seventy h.p. to 800 h.p., a truly remarkable selection from which to choose.

This fact is apparent from the chart, Fig. I, in which are plotted curves of our proven engines. This chart includes only those engines which have been or are in production and gives a conservative power rating based on normal compression ratios. It does not include experimental or semi-experimental engines which will be covered later in this paper.

From the chart it will be seen that there are two proven engines in the 200 h.p. field. These are the Wright Model "E" and the Wright Model "J." The former is the old Hispano-Suiza expanded and developed to the point where it is without exception the most durable engine in the world. It was this engine that completed successfully a 300-hour endurance run at the Aeronautical Engine Laboratory. The Model "J," now being built as the J-4, is the old Lawrence "J" engine improved and developed to the point where it has now taken its place as a standard engine in the Navy for training, observation, and fighting airplanes. One of these engines has lately finished 150 hours of dynamometer test running, the last fifty hours of which were run at full throttle at 1,800 r.p.m. The Vought *UO-1* airplane about this 200 h.p. engine is comparable in every way in performance with the old DH about the 400 h.p. Liberty. Aviation owes to the vision of Lieutenant Commander B. G. Leighton and Charles L. Lawrence, vice-

president of the Wright Aeronautical Corporation, its possession of this engine today.

In the 300-400 h.p. field our chart shows the incomparable Curtiss D-12. This engine is without an equal in its class. Powerful, rugged, dependable, smooth running, it has established itself in the Boeing and Curtiss pursuit airplanes as one of the remarkable engines of today. Its ability to withstand the very high rotative speeds that occur in a dive is one of its outstanding characteristics.

In the 400-500 h.p. field the Liberty is, by its physical characteristics, restricted to about 1,700 r.p.m. However, the new Packard 1A-1500 fills this field admirably. This engine has not yet taken its place in quantity production but it has passed its experimental stage with a surprising performance and a number are now being put into the air for flight testing.

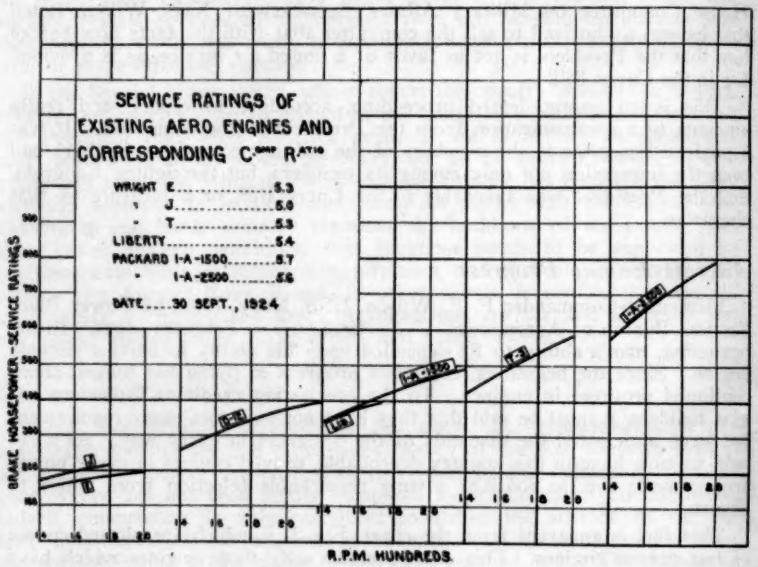


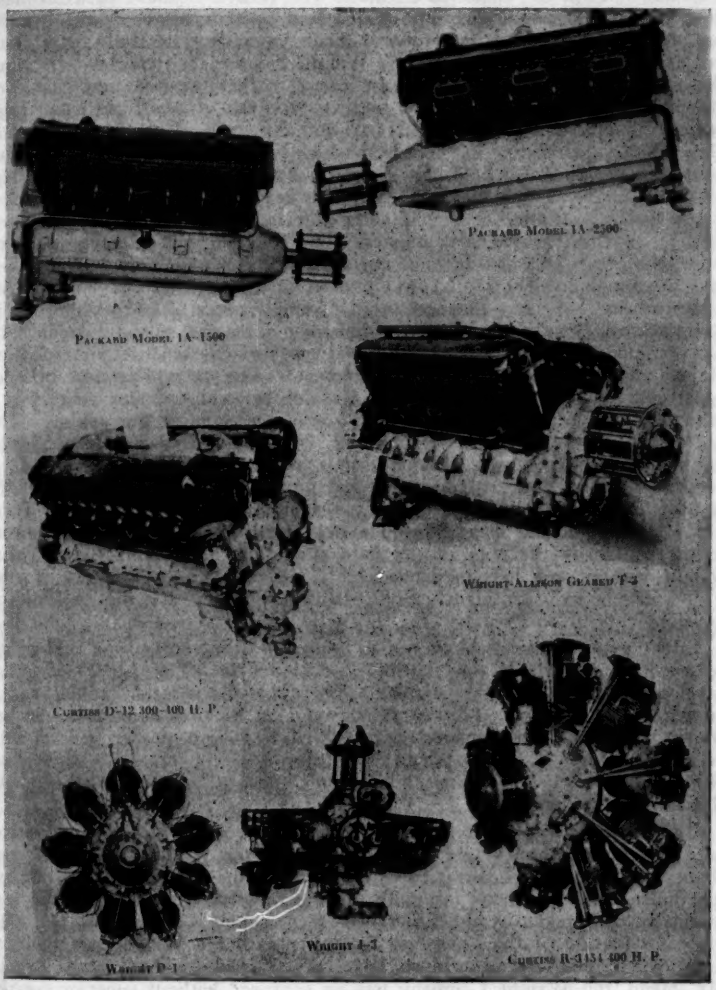
FIG. I

In the 500-600 h.p. field, the Wright Model T-3 is supreme. Originally intended for a 500 h.p. engine, this model has been expanded and developed to the point where it is now easily a 600 h.p. engine and at that rating capable of surprising durability. This engine holds the world's endurance record for seaplanes in the *CS-2* and *SDW-1*. It also holds a number of records in the *PN-7* flown at the Baltimore air pageant. Two of these engines had over 275 hours of flying with only the most minor overhaul prior to their removal from the *PN-7*. They were removed then only in anticipation of the long winter cruise and upon examination were found to be as good as new.

In the 600-800 h.p. field, the new Packard 2,500 looms as one of the outstanding developments of the year. This engine, because of its high power and smooth running, would be remarkable enough. In addition, however, it is one of the lightest known engines for its horsepower. It was the Navy's

choice for the new experimental Boeing patrol airplane, and in this airplane will be fitted with Allison reduction gears with a 2-1 ratio.

As Lieutenant Commander Leighton has so aptly put it, the story of aircraft engine development is written in the words "pounds per horse-



Outstanding American Aviation Engines

power." We have examined the proven engines from the horsepower viewpoint and it is equally interesting to look at them from the weight standpoint. The chart, Fig. 2, shows the same service engines plotted on a basis of horsepower and pounds per horsepower in a flying condition. It is futile, of course, to compare engines on a dry weight basis. This chart

shows them compared on their flying weight: that is, installed in the airplane ready to take-off as soon as gas, oil, and water are supplied.

In the upper right-hand corner, the broken line is a median line for all the watercooled engines. In the lower left-hand corner, the broken line is a median line for the aircooled engines. The vertical ordinate between these lines is about .7 pound per h.p., which is a good average weight for the cooling system. In the watercooled field, we note that the Curtis D-12 lies exactly on the median line; the Wright E-4 and T-3 engines are above this line. It must be remembered, in justice to these two engines, that considerable weight has been added to them because of over-speed and high power running. The Packard 1A-1500 and the Packard 1A-2500 are found close to the median line in a position which very unique construction places them. In the aircooled field, the Wright J-4 and the Wright P-1, a 400 h.p. aircooled engine which has just passed its tests, make up the line.

As has been stated, the outstanding development of the year has been the rise of the two Packard engines. The splendid weight-power ratio of these engines is not due in any way to freak construction. Neither is it due to skinning off essential weights or to the use of special material arrangement, however, they are unique, and Captain L. M. Woolson, of the Packard Company, is to be congratulated on the splendid balance he has obtained between adhering to proved types of construction and adopting rather radical departures in arrangement. The new Packard cylinder construction is so designed that the distance between cylinder centers is a minimum. This makes it possible to greatly shorten-in the engine. The bore-stroke ratio of approximately one is chosen to give the engine the minimum over-all height. An ingenious arrangement of valves makes it possible to drive four valves per cylinder off a single overhead camshaft. A neat arrangement of accessory drives reduces the number of drives from 5-2. A novel double magneto and a neat arrangement of the distributors in the center of the Vee results in a saving of about half the magneto weight without any loss in dependability. These two engines are worthy of an article by themselves. Suffice it to say, they are the outstanding developments of the year.

In the experimental field there has been a healthy competition. This has centered particularly in the 400 h.p. aircooled field. The Air Service has developed, with the Curtiss Airplane and Motor Corporation, a new radial known as the R-1454. This engine is now on its fifty-hour test and has shown remarkable performance on a basis of its weight, power, and smoothness of running. E. T. Jones and S. D. Heron, in cooperation with Arthur Nutt, of the Curtiss Airplane and Motor Company, have achieved remarkable success in this engine.

Under the Navy's supervision, the Wright Aeronautical Corporation has been developing the Wright radial known as the P-1. This engine has about 200 cubic inches more displacement than the Curtiss radial. It has just finished its fifty-hour test with the greatest success. This engine was originally undertaken by the Lawrance Aero Engine Corporation, but with the consolidation of the Lawrence Company with the Wright Aeronautical Corporation, work has continued by George Mead of that company. In Mr. Mead, the Wright Company has an engineer without superior, as the long line of successful Wright engines will testify.

Important developments have taken place in the field of engine accessories. As a matter of fact, the engines have more or less outstripped their accessories in the past few years and attention is now being focused on these accessories. One of the outstanding developments is the Aeromarine inertia hand starter developed by Roland Chilton. Mr. Chilton is known in the aircraft engine field as a very clever designer and this hand starter bears

out his reputation. In this device, by turning a crank, a high velocity is imparted through gearing to a flywheel. By a suitable tripping device, this flywheel can be engaged with the crankshaft where it exerts enough of the stored-up energy to spin the engine rapidly and start it at once. This starter has been very successful in service. Parallel with this starter development, which was fostered by the Navy, the Air Service has developed satisfactory electric starters of the Bijur type in which provision is also made for hand starting.

One of the difficulties of the past has been found in gasoline pumps. Because of the characteristics of gasoline, it is impossible to lift gasoline from low tanks. The Air Service has overcome this difficulty by using the flexible drive shaft in the round-the-world cruisers where it was so successful that both the Navy and the Air Service will use it wherever it is indicated. Parallel with this, the Navy has been developing a fuel pump of unique design. This work has been in the hands of Warren Noble, of the Kinney Manufacturing Company, who is known for his clever designing of ingenious types of mechanism. In this system, an actuator on the engine transmits pulsations back through the fuel supply line to a spring-operated pump which can be located conveniently. The fuel system is, therefore, much simplified. Tests are now being conducted to determine the reliability of this device.

In the field of ignition, magnetos have replaced battery-generator ignition in a number of installations. Whenever current is required for other purposes, such as landing lights, the battery-generator system may be required. In small airplanes where the current requirements are not great, the magneto ignition holds the field because of its simplicity. Magneto ignition has not been entirely satisfactory insofar as ruggedness is concerned, but it is anticipated that before the close of 1925 this problem will be solved.

Certain parts of the engines themselves have come in for improvement. The outstanding development of the year along this line is the astonishing success of the Allison Engineering Company's steel-backed babbitt bearings. By virtue of its stiffness, steel has proved to be a superior backing for babbitt bearings. These bearings in a Liberty engine greatly increase the life of the engine. It seems likely that they will replace all other types in both main and crank pin bearings. The Allison Company has also solved the problem of gears for engines so that now these gears can be built in quantity and of a reliability superior to that of the engine itself.

Under the supervision of E. T. Jones, chief of the power plant section, McCook Field, another striking development has taken place. This is in the adaptation of the Moss type supercharger to different engines. The device finds two uses: (1) supercharging for high altitude work; (2) rotary induction to improve the distribution at low attitudes. The smooth running of the Curtiss R-1454, in which this supercharger, manufactured by the General Electric Company, is installed, as ascribed to this blower. This development has focused attention on the supercharger as a practical service proposition with the result that its employment will be extended in the coming year. Simultaneously with this development, the National Advisory Committee for Aeronautics is working with the Roots type blower at Langley Field and has had great success. This gives a choice of two superchargers for future development.

Higher powers as a result of employing higher compression ratios in engines are dependent upon the development of suitable non-knock fuels. The Bureau of Aeronautics has pushed this development in the past year, but up to date has found no absolutely satisfactory solution. A blend of benzol, alcohol, and gasoline serves the purpose but is not entirely

satisfactory from a viewpoint of smooth running and easy starting. Benzol-gasoline blends are not entirely satisfactory because the benzol tends to crystallize as ice at low temperatures, and benzol is not available in sufficiently large quantities. Two special fuels are being investigated and while they are sufficiently non-knock, they will need further development before they are entirely satisfactory. It is hoped that continued investigation will produce some results in this important field.

A summary of developments would hardly be complete without a statement of the possibilities of the future. In general, development has taken two forms, (1) the continued refinement and improvement of standard types, and (2) the investigation of interesting experimental types. At McCook Field, the Air Service is experimenting with the Almen, or

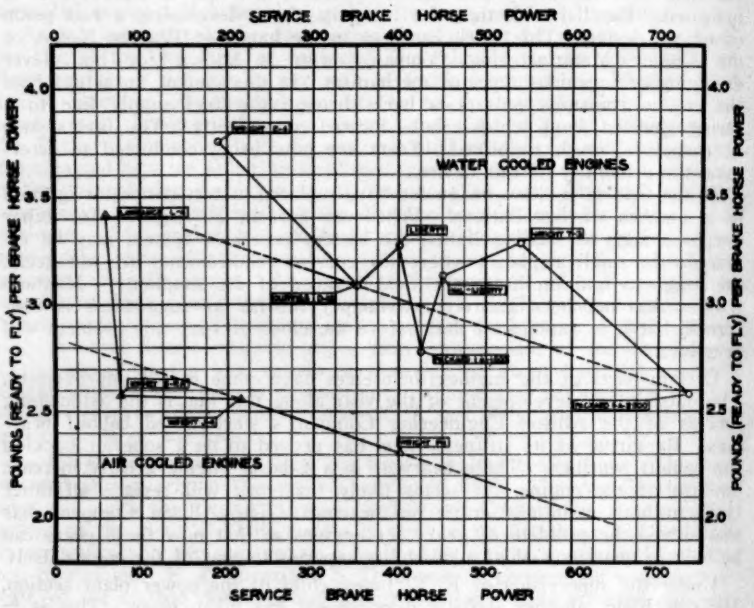


FIG. II

barrel, engine, and the cam engine in which a large cam replaces the cranks. The Navy has on order an experimental heavy oil engine for possible use in rigid airships. The success of the Inverted Liberty and the Inverted 1A-1500 engines focuses attention somewhat on the X-type engine. Four banks of four cylinders each in the X-form may be the ultimate compromise between the long in-line engine and the short radial engine.

One of the most promising possibilities, particularly for the water-cooled engine, lies along the line of crankshaft speeds in the neighborhood of 3,000 r.p.m. with a 2-1 reduction gear giving 1,500 r.p.m. to the pjropeller and a supercharger capable of maintaining the engine power proportionate to the crankshaft speed. On an increase of not over fifteen per cent in weight, such an engine could readily have a forty per cent increase in power. It is not difficult to imagine that such a power plant in a single bomber, similar aerodynamically to the Curtiss or Boeing pursuit airplanes,

will give us, within a few years, speeds of 150 to 160 miles an hour in the heavier types of aircraft quite as readily as we now attain them in pursuit alone.

The statement is made from time to time that the limit in aircraft engine development of the present type has about been reached. About the time this statement is made, however, something like the Packard engine comes along to upset all ideas. In the 1,000 h.p. field, an engine having a dry weight of one pound per horsepower is readily attainable any time the necessity for such an engine is apparent. As long as the present designers, such as Mead, Woolson, Nutt, Chilton and Noble are in the industry, it cannot be said that the present type of engine has anywhere near reached its limit. As long as the people responsible for this engine development adhere to the presnt policy of improving standard types and fostering a healthy development of new types, the future of aircraft engineering in this country is assured.

*The Flettner Rotor Ship**

By Von Auton Flettner

Engineering, 23 January, 1925.—After my rudder for aircraft and ships had been brought to a state of practical development, I occupied myself with the furtherance of my principle of the control of large surfaces by means of a small one for the wind propulsion of ships. My original idea was to substitute metal for canvas sails, built like the wings of modern aircraft. These were to be pivoted like a weather-cock, in a precisely similar manner to my rudder, and controlled by a steering surface. The theoretical data available on the subject of sails was very primitive and in many respects even incorrect. As I was seeking to produce an improved sailing device, I had to begin by exploring the effect of the wind upon ordinary sails. I therefore started a research in the Göttingen Aerodynamic Experimental Laboratory, first with models of canvas sails and later on with metal sails.

As a result of these experiments, a definite improvement was shown to be possible by the use of metal bodies controlled by pilot surfaces, in place of sails. The arrangement involved, however, a large area of metal surfaces by which the construction was complicated. For this reason I was not satisfied with the results and looked round for further possibilities. Thus, among other things, experiments were conducted on the feasibility of a wind turbine, the sails of which would be adjusted by my steering system. The practical application of an idea of Prandtl was suggested by the managers of the aerodynamical experimental laboratory of Göttingen University, Dr. Betz and Herr Ackeret, by which the efficiency of the driving bodies would be increased by the induction of the "boundary layer."

In this field also, I had various experiments made, which showed that even greater difficulties lay in the way of a practical solution of the sail problem in that direction. The difficulties involved in the use of large steerable wings, with regard to their behavior in gales, reduced the problem to one of finding the simplest possible arrangement which would be unaffected by storms. In the beginning of 1922, I was already occupied with the idea of producing artificially a circulation in the current round surfaces of symmetrical section, fixed immovably to the ship. The ship would be steered by altering the direction of circulation of this artificially-induced current. I covered this idea with a German patent on September 17, 1922. While working in this field, I conceived the idea to use as sails fixed

* Abstract of a paper read before a meeting of the Schiffbautechischen Gesellshaft on November 21, 1924.

which would be combined with a rotating skin; later of the single cylinder. surfaces round which a skin was rotated. I thought first of two rollers I was strengthened in my opinion when, at the end of 1922, I read Professor Föttinger's work *New Bases for the Theoretical and Experimental Treatment for Propeller Problems.* The consideration that special machinery would be necessary to produce the rotation had first of all restrained me from using the idea and patenting it.

In 1853 the eminent physical experimentalist Magnus, in Berlin, published his discovery in *Poggendorf's Annals,* under the title "The Drift of Shells." Magnus carried out his experiments on the effect of the wind on projectile-shaped bodies, principally from the point of view of ballistics. A shell, rotated by the rifled gun-barrel, is affected by a side wind directly its axis ceases to coincide with the tangent of its trajectory. Through the effect of its rotation, this side wind brings into play the above-mentioned transverse force, perpendicular to the trajectory, which is very annoying to the gunner. Magnus had established by his experiments that a rotating, cylindrical body blown upon at right angles to its axis by a wind, not only offers the usual resistance, but also receives a force directed toward that side of it on which the relative wind speed and peripheral speed are most nearly equal. Lord Rayleigh has dealt with similar phenomena in tennis balls, in a short essay on "The Irregular Flight of a Tennis Ball." He mentions that a current must circulate the ball, without going deeper into the question of the current. Lafay had already made similar measurements over ten years before in Paris.

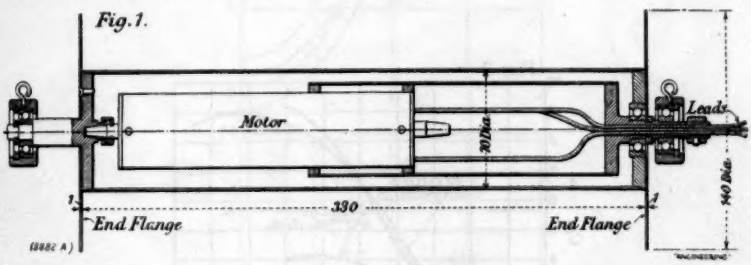
The Göttingen laboratory had repeated Lafay's experiments for purely theoretical reasons, at the end of April, 1923, on the suggestion of Herr Ackert, one of their departmental heads, since their plant was particuularly suited for such a course of experiments. The laboratory staff had no idea of putting the effect to practical use. They only refrained at first from publishing their results as they intended to study the effect later with better means. When I heard of the Göttingen experiments, I realized the danger that someone might anticipate me by lodging an application for a patent, especially as I had had research work carried out in Göttingen on other lines, but on the subject of sails. I therefore applied immediately for a patent. I made the first experiments on water, on the Wannsee, near Berlin, with a little model ship which carried a paper cylinder, driven by clockwork, and 15 cm. in diameter by 40 cm. high. After these experiments, I informed the Göttingen authorities of the matter, and it was agreed that further research work on rotors, especially as far as their use as sails was concerned, should be carried on at the expense of our company. I would state here that the first repetition of Lafay's experiments dealing with the Magnus effect was undertaken independently by us; that the adaptation of the principle to the sailing ship was my idea only, and that it was developed on my account and at the expense of my company. As I heard later from Göttingen, the principle had already been proved to give much higher values than had been found by Lafay, even before we started the experiments from a practical point of view. I might mention that my ideas were met at the outset with surprise on the part of those gentlemen who had already been occupied with quantitative experiments on the Magnus effect. It must not be forgotten that, so far, no even approximate estimate was possible of the force required to rotate the towers, of the weight of the high towers themselves, of the vibrations induced by the rotation of these great bodies, and the effect that this would have on the ship, of the behavior of the towers when not turning in gales, and so forth.

The proposed large metal cylinders, which are arranged on the ship to

turn freely, constituted indeed the most difficult scheme of the type attempted. Considerable doubt was expressed concerning the feasibility of the idea, particularly by naval architects. Even my collaborators were sceptical up to the last weeks, as to the results of the experiments, and warned me not to over-estimate the value of the partial results which we obtained in experiments at the shipyard. Aerodynamical experts also considered the building of a full-scale plant solely on the results of experiments with such relatively small models as quite unjustified.

Fig. 1, shows, in section, one of the experimental rotating cylinders, which is constructed in one with its motor. It is made of brass tubing and is 35 cm. long by 7cm. diameter. The armature of the motor is attached to the cylinder, and is carried in a ball bearing in the stator, which is suspended so that it may be turned about its axis in order that the torque necessary to cause rotation may be measured. Current is led to the motor by three wires passing through the hollow spindle. Free movement is assured by mercury contacts. At the ends of the cylinder will be noticed two flanges. Professor Prandtl had suggested these at Göttingen, to keep the vortex as near as possible to its theoretical value, while I had independently included them in my patent for the practical design of the rotor ship, to reduce loss of effect at the ends of the cylinder, without knowing of this previous use of them. Fig. 2 shows certain of these results. In the curves shown here the scale of values for propulsive power and for

Fig. 1.



resistance are taken as equal. The c_a "lift coefficient" values are relative to the banking-up pressure and the superficial area of the cylinder. For comparative purposes, the curve of a very good aeroplane wing of the usual type, is included in the diagram, and is indicated by the dotted curve. That of a sail would be so poor in comparison that it would not even reach the value 1. One can see immediatly, from this curve, the remarkable contrast in absolute value of propulsive effort and resistance value between the usual wing section and the rotor. The fully developed curves are those of cylinders with flanges of different diameter as compared with a cylinder without end flanges. The great effect of the end flanges is visible here, and explains why Lafay, who had not thought of using them, only obtained propulsive effort values up to about 2. On comparing the curves, it can be easily seen that the induced resistance is greatly reduced by means of the end flanges. The curves in Fig. 3 show the influence which the relationship between speed of rotation and wind has on the propulsive effect. When these speeds are equal, this is already greater than with an ordinary sail, the value of which is about 0·8. When the peripheral speed of the cylinder is 3·5 times the wind speed, the propulsive effort has already reached a value of more than ten times that of a sail. Here also the influence of the end flanges is plainly apparent.

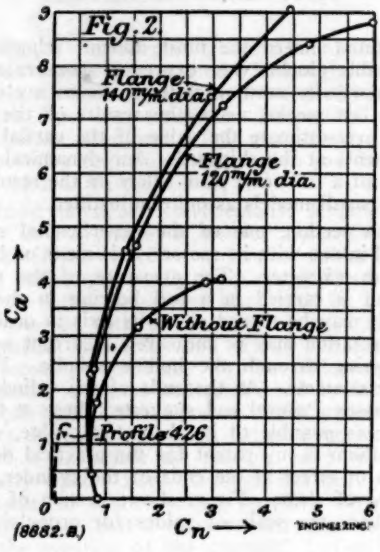


Fig. 2.
Flange 140 m/m. dia.
Flange 120 m/m. dia.
Without Flange
Profile 426
Ca
Cn
0
1
2
3
4
5
6
7
8
(8882.a)
"ENGINEERING"

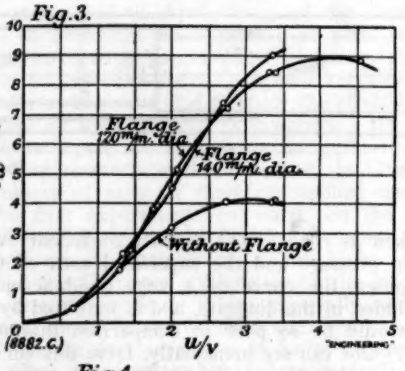


Fig. 3.
Flange 120 m/m. dia.
Flange 140 m/m. dia.
Without Flange
Ca
u/v
0
1
2
3
4
5
6
7
8
9
10
(8882.c.)
"ENGINEERING"

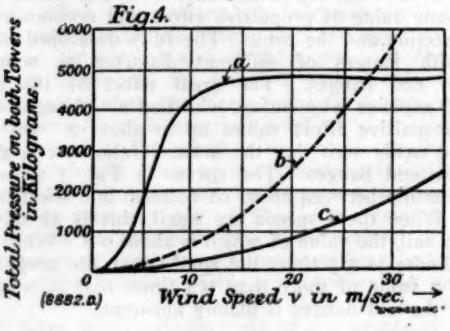
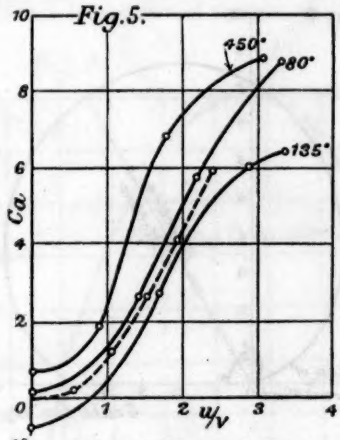
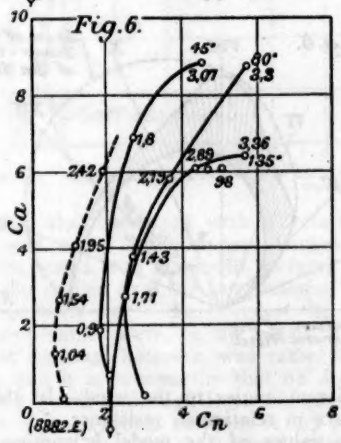


Fig. 4.
Total Pressure on both Towers in Kilograms.
a
b
c
0
1000
2000
3000
4000
5000
6000
10
20
30
Wind Speed v in m/sec.
(8882.a)
"ENGINEERING"

The curve, Fig. 4, shows clearly the nature of the forces involved with the cylinder rotating and at rest, compared with the resistance of the usual rigging of a ship. Curve *a* shows the pressure on both towers, with a peripheral speed of 24 m. per second. Curve *b* shows the wind resistance of the rigging, *c* that of the cylinder when not rotating. It is plainly shown how the effect on the rotating cylinder ceases to increase beyond a wind of about 12 m. per second. This is a matter of the greatest practical importance. No more force is taken from the highest winds than is appro-





priate to the peripheral speed. This advantage cannot be too strongly emphasized from the point of view of sailing. The mariner will always be able to derive propulsive power from the strongest gales, provided of course, that he is not prevented by nautical reasons, such as too high a sea. Should the rotor for any reason stop rotating, the resistance of the cylinder is, as the curve shows, very much less than that of the bare rigging. It is possible, at will, therefore, to obtain any of the conditions lying between curves *a* and *b*.

The graphs, Figs. 5 and 6, show results obtained with a scale model of the *Buckau* with two rotating cylinders. This model was made to determine the effect produced by both cylinders and by the hull. You see here the propulsive forces c_a plotted in relationship to the $\frac{u}{v}$ ratio, where u denotes the surface speed of the tower and v that of the wind. The different curves show very distinctly the changing effect of the hull and of

Fig. 7.

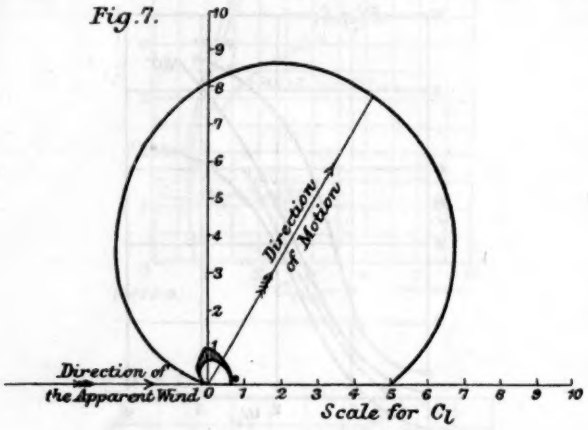
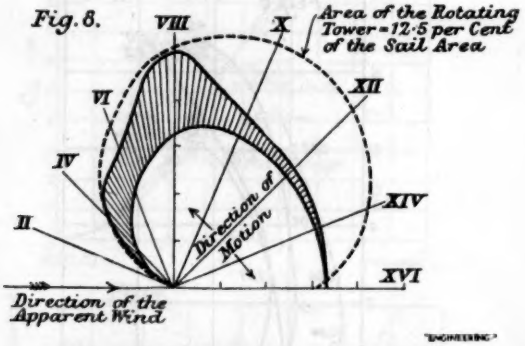


Fig. 8.



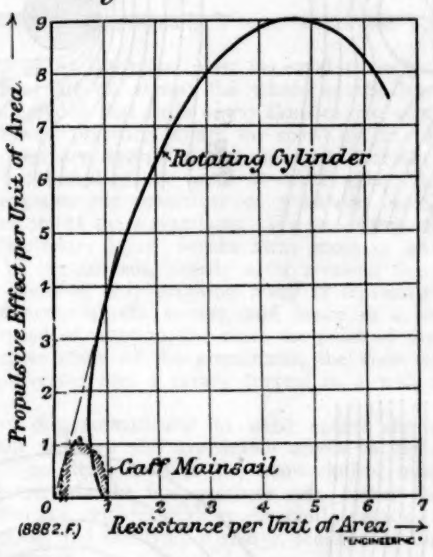
the cylinders at different angles to the wind. In the diagram Fig. 6 is shown propulsive force in relation to resistance.

Fig. 7 shows the values of the model brigantine *Buckau,* plotted on the same scale as those of the model of the same ship with both towers revolving in the right direction for forward motion. The enormous advantage of the rotating cylinders, compared with sails, is once more illustrated. While values were attained with the brigantine in the neighborhood of 0·8, those given by the model with rotating cylinders amount to between 8 and 10, according to the diameter of the end flanges. More than ten times the power derived from sails is given by the rotating cylinder, as has been proved by such tests as have been carried out on the *Buckau.*

From Fig. 7 may be taken the relationship of the forces brought into play with the course of the ship at different angles to the wind.

In Fig. 8 the curves of the brigantine and the rotor model are plotted so that the relationship of the forces may be studied when the projected area of the cylinder is one-eight that of the sails. The lower curve shows the values with unfavorable trim of sails, the uper one those with an ideally favorable setting. The actual curve should run half way between the two. Fig. 9 shows the comparison between the performance of an exceptionally good gaff mainsail and of a rotating cylinder of the same projected area. The curve is not carried further, as the experiments were not completed.

Fig. 9.



An experiment was also conducted with a rotating cylinder with a fluted surface, 800 mm. high, and with end flanges 280 mm. diameter. This cylinder was first tested with a smooth surface. The results agreed, on the whole, with the earlier ones. After flutes of a width of 10 mm. and 3·5 mm. deep had been cut in the cylinder, the experiment were repeated. The propulsive values were, on the whole, good. The resistance with the cylinder not rotating, however, was rather large compared with the smooth cylinder, and it is noteworthy that no drop in resistance was observed at the highest speeds with high Reynolds numbers. The resistance of the cylinder with high Reynolds numbers is 0·7 instead of about 0·3. On this account we at once gave up the idea of using a grooved cylinder for our purposes.

Before I now go on to the practical experiments with, and the construction of the *Buckau*, I should like to deal with the theory of the Magnus effect. It is not yet possible to describe the action of the wind currents. Professor Prandtl's "boundary layer" theory, however, provides a plausible explanation of the phenomenon. Professor Prandtl asserted twenty years ago that the frictional effect of a fluid is restricted mainly to a proportionately thin layer near the body, that is, to the

Fig. 10.

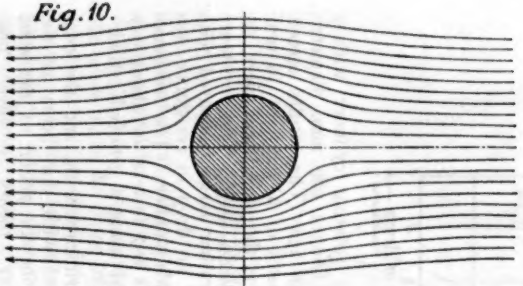
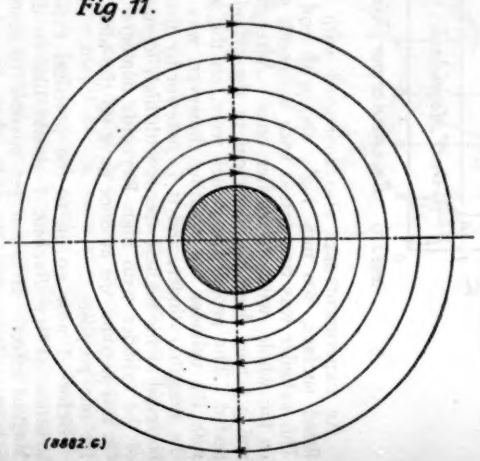


Fig. 11.



(8882.6)

Fig. 12.

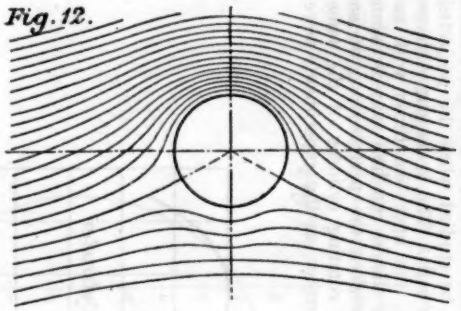
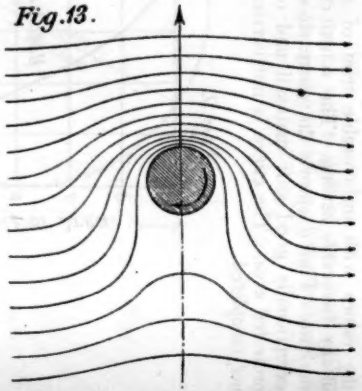


Fig. 13.



so-called "boundary layer," which in most cases prevents the formation of ideal stream-lines according to the "potential" theory. Fig. 10 is an illustration of the true potential current. Fig. 11 shows the rotary current which can be imagined as imposed upon the potential current. This would resolve itself into a potential current with some rotary movement (Fig. 12). All these matters have been frequently studied and fully described.

Fig. 13 shows diagrammatically what happens when a true potential current meets a rotary current of very great velocity. The astonishing effect of this condition of current round a rotating cylinder is the sudden increase of pressure. Under the full influence of the "boundary layer," such a rise in pressure would not be possible. The rise in pressure would have a result much more gradually. With a suitable proportion of $\frac{u}{v}$, the peripheral speed of the rotor must be equal to or greater than that of the molecules of air on almost the whole of the low pressure side. It must not be concluded that little or no skin-friction occurs, particularly at the point of lowest pressure, where the speed of the rotating wall and of the air molecules are approximately equal, or that therefore an inert "boundary layer" either does not occur at all in this zone, or only very slightly. This explains the possibility of a sudden increase in pressure without a breaking up of the streamlines. We know that with the cylinder motionless, the "boundary layer" breaks away more or less symmetrically to the direction of the current, shortly after crossing the zone of lowest pressure. With rotation, this breaking away is markedly unsymmetrical resulting in asymmetry of the stream, and hence in a propulsive force. The higher the speed of rotation, the more the point of the break away is shifted. After close study of the phenomena, the view is suggested that the air becomes diverted into a rotary current in a wide area round the cylinder.

Fig. 13 shows diagrammatically to what extent the streamlines approaching the high pressure side are drawn across to the side of the low pressure. It will be clear, even to the non-technical mind, that the air prefers to move towards the low pressure side, rather than to the high pressure side, when the cylinder wall is constantly rotating against it with many times its speed, and builds up a rise in pressure as high as the speed of the wind will permit.

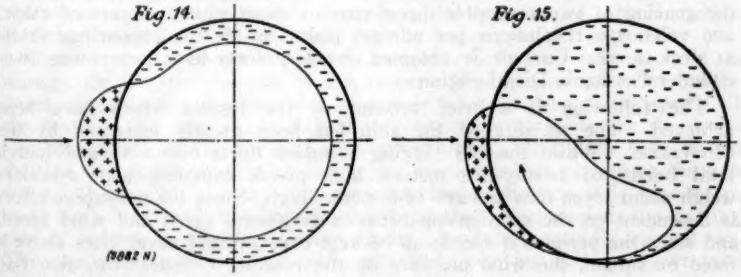


Fig. 14 shows the proportion of pressure to suction on a non-rotating cylinder, as has been already described by Lafay and others. The area denoting pressure is marked with plus signs, that of suction with minus signs. Fig. 15 shows the distribution of pressure when the cylinder rotates,

with a peripheral speed of three or four times that of the wind. In this instance, I might have been tempted to give you a nice illustration showing an area of low pressure on one side and a proportionate area of enormously high pressure on the other. In my various papers on the current operated rudder, I have always laid emphasis on the fact that in all applications of the laws concerning currents, the low pressure side is the most important and that when it is desired to utilize to the fullest extent the forces latent in currents, the side of low pressure must be considered first and care taken to make use of the possibility to induce a high degree of suction. In aircraft design, this point has been made the most of by practically every designer, while in shipbuilding circles it has not yet been given the attention which it deserves. From this diagram of the distribution of pressure, it is possible to see the approximate direction of the resultant force. Our problem was to construct a rotating cylinder in such a way that the resultant force acted as nearly as possible at right angles to the direction of the wind. It may be taken for granted that with a very high proportion of u to v, the resultant departs from the perpendicular from 90° to 130°. With a favorable proportion of diameter to height of cylinder and with end flanges of suitable size, a very near approach is made to the ideal right angle. With careful design, an angle of 100° to 120° can be obtained between the wind direction and the direction of the resultant pressure. This fact explains the ability of the Buckau, in spite of the unfavorable influence of the hull, to sail within three points (that is, about 30°) of the wind.

For full scale experiments, the auxiliary three-master topsail schooner *Buckau* was chartered by Messrs. Krupp from the Hanseatic Motor Ship Company of Hamburg. Two fixed shafts without stays were built into the hull, of 1·5 m. diameter at the main deck and 13 m. high above deck. Surrounding the shafts were two cylinders arranged to turn on two bearings, and built of steel sheets 1 mm. thick, stiffened crosswise and vertically. The cylinders have a diameter of 2·8 m., and were first built 15·6 m. high. This represented an area equal to about one-tenth of that of the old sail plan. An increase in height to 18·5 m. was seen to be necessary after the first few long trips. The upper bearing is designed to take side thrust, and at the same time to carry the weight of the cylinder. The lower bearing deals with only small pressures. In this first installation, ball bearings were used throughout.

The cylinders are rotated through gearing, having a ratio of 6-1, and arranged at the upper bearing. Vertical driving shafts lead down from the gearing of two reversible direct current shunt-wound motors of 11kw., 220 volts, 750 revolutions per minute, placed inside the supporting shafts at deck level. Current is obtained from a forty-five horsepower two-cylinder Germania Diesel engine.

The following is a brief account of the results which have been achieved. The stability of the ship has been greatly increased by the conversion. While the old rigging weighed thirty-five tons and had a total height of twenty-five meters, both pivots complete with cylinders weigh about seven tons and are 15·6 meters high. Since the propulsive effort is dependent on the relationship between peripheral speed and wind speed, and since the peripheral speed can be kept constant and never rises above a fixed maximum, the wind pressure on the rotating cylinders can also rise only to a certain height, even if the wind speed itself increases enormously. Hence the rotors can continue to function in very high winds. For this reason also, very strong squalls have but slight effect on the ship, and pass almost unnoticed. When, for example, the rotor is turning at a peripheral speed of twenty-four meters per second, in a wind of eight meters

per second, and a squall of eight to twelve meters per second passes, the ratio of $\frac{u}{v}$, which at first was three, is automatically reduced to two. In spite of the fact that the wind itself has grown much stronger, its effect on the rotor is thus automatically relatively reduced, so that practically no increase in pressure is noticeable. The phenomenon, which could be anticipated from calculations based on the experiments, was amply confirmed by the first trial trips. In this particular lies a great advantage as compared with the old sailing ships. One can control absolutely the wind pressure on the ship, by rotating the cylinders at a suitable speed, and almost instantaneously. It is thus unnecessary, as was the case with the old sailing ship, to start shortening sail long before the aproach of a storm. Moreover, as already mentioned, the resistance of the stationary rotor is low, compared with that of the old rigging with sails stowed.

In the course of the research with cylindrical bodies, it was found that the resistance value does not only depend on the form and position of the moving body, but that a geometrical similarity must also exist in the stream-line form. This similarity occurs only under quite definite conditions which have been determined by Reynolds. It was established that the resistance of cylindrical bodies of a certain diameter does not increase with increasing wind velocity per unit of superficial area, but that according to the given conditions, there is a sudden drop in the curve of resistances. According to the Göttingen figures, a resistance value of about 0·3 is to be reckoned on with our three-meter diameter cylinder at the wind speeds with which we have to deal, since the Reynolds numbers concerned lie beyond the critical value. It can be calculated that the surfaces which must remain standing in a storm, that is, masts, shrouds, yards, standing and running rigging, amount to twelve to fifteen per cent of the total area, from which a resistance value of 1 to 1·2 is to be reckoned on, since these bodies have a very unfavorable form from the point of view of resistance. As the curve shows, the total resistance of the cylinders is much lower than that of the old rigging with furled sails.

Irregular forces, brought into play by the rolling and pitching of the ship, were found after careful calculation to be extremely low and never to reach a value of any importance. The periodicity which might be set up in the transmission by lack of balance of the cylinder, was found by calculation never to reach a dangerous degree. The actual trials of the ship have also proved that any fears on this account are groundless. Damage of the cylinders by seas is scarcely to be apprehended. Nevertheless, a thicker gauge of plate was used for the lower part of the rotors.

Control at sea is extraordinarily simple. Only one man is need to manage the electric controls of the rotors. Weather or lee helm can be counteracted in the simplest way by merely altering the relative speeds of the rotors. The ship can be helped in going about by reversing the direction of rotation of the forward or after cylinder. The trials have shown that the ship is not brought up during this maneuvre, but carried on through the wind's eye like a yacht. By reversing both cylinders, it is possible to move full speed astern. Due to the duplicated transmission, the driving gear is extremely reliable. Getting under way is also rapidly carried out. The operation corresponding with setting or stowing sail does not take any length of time, but can be carried out in a few seconds. It is no longer necessary to keep a careful eye on the barometer and weather signs, so as to prepare ahead for changes of weather. The mariner is able instantaneously to adjust his vessel to any sudden change.

Even considerable changes in the direction of the wind need not be

taken into account, as the rotors need no modification to meet them. It is only necessary to reverse the rotors when the wind comes on the other side of the ship. Apart from slight variations in their speed of rotation, to meet considerable changes of wind speed, the rotor require practically no attention. When sailing close-hauled, the proportion of $\frac{u}{v}$ is somewhat reduced, and it is increased when running free.

As has been frequently mentioned, the trials have proved that all expectations which were based on the Göttingen experiments have been entirely fulfilled. The efficiency of the system has been satisfactorily proved. I have always been of the opinion that the new system would never replace the modern steam or motor-ship, but that it would have a definite value as an auxiliary to the highly developed engine for ship propulsion, by utilizing to the full the available wind power, and it would thus effect great economies in fuel consumption.

ORDNANCE

Airplane Catapult

Report Chief Bureau Ordnance.—A new type of airplane catapult has been developed conjointly by the Bureau of Ordnance, Bureau of Aeronautics and Bureau of Construction and Repair. Smokeless powder is used as the propellant in the new type of catapult and most excellent results have been obtained. By using this type, a more reliable catapult has been obtained, and the use of compressed air with its cumbersome and expensive compressing machinery has been obviated. Incidentally, the design has been simplified and the general arrangement made very much better for installation on board ship.

NAVIGATION AND RADIO

Short Radio Wave, Sent High Into Air, Opens New Field

Washington *Post,* 20 February, 1925.—Cleveland, February 19 (By A. P.).—Two important revelations were announced by Dr. E. F. W. Alexanderson, General Electric Company radio expert, addressing the American Institute of Electrical Engineers here tonight.

The first is a system of short radio waves projecting high into the air which are not heard until they descend to the earth again.

The second is the successful scrambling and unscrambling of radio waves.

Dr. Alexanderson also told how practically all static has been eliminated by the construction of an antenna system consisting of two antennæ ten miles long joined by a transmission line.

Long radio waves, such as are sent out from popular broadcasting stations, cling close to the earth's surface, Dr. Alexanderson said.

"So long as we are working with earthbound waves we must use long waves for long distances because the earth absorption of the long waves is comparatively small," Dr. Alexanderson said. "When, on the other hand, we use high angle radiation with short waves we utilize a different form of wave propagation. These new tracks in the ether are being explored by systematic research work as well as by commercial communication.

"Thus a new phenomenon or law of nature has been established, though we are not able to give an adequate explanation. The curved space radiation with short waves will undoubtedly open up new and open fields for radio.

"The short-wave lengths open up not only new paths for wave propagation, but give us an almost inexhaustible scale of wave lengths provided we utilize it to full advantage."

Speaking of the scrambling and unscrambling process, Dr. Alexanderson said:

"Signals from Europe are picked up in Belfast, Maine, scrambled together and sent into one wave band by a single transmitter to Riverhead, Long Island.

"At Riverhead they are unscrambled into a dozen signals, which are fed into the long wave receiving sets where they go through the usual process of detection and transmission to New York.

"The signals so reproduced are exact replicas of the original, and operators receiving them in New York are unable to distinguish whether they are the original signals or the scrambled and unscrambled signals.

Dr. Alexanderson said the scrambling process is the realization of dreams of John Hays Hammond, Jr., many years ago.

"The fight against atmospheric disturbances and static has led us to build on Long Island a central receiving station with an antenna system consisting of two antennæ ten miles long joined by a transmission line," Dr. Alexanderson continued. "This system eliminates practically all the static and intercepts on one antenna all the signals from stations in Europe.

"These signals are then automatically separated out in more than a dozen receiving sets, and sent by wire to New York.

Navy Tries to Develop High Frequency Wave

Washington *Post*, 15 February, 1925.—The Navy Department is centering its radio activities in the development of high frequencies or short waves in the belief that they will open up an entirely new field. Captain Ridley McLean, director of naval communications, is planning elaborate experiments in this connection in the next six months.

"The possible development of reliable long distance radio communication in the naval service on high frequencies with low power," Captain McLean says, "recently has been brought forcibly to the attention of the Department, principally because of the successful long distance reception at Balboa and San Diego for regular traffic despatches by the experimental high frequency transmitter at the Bellevue laboratory.

"Some idea of the possibilities of this method may be had if consideration be given to the fact that the only antenna used at Bellevue for this long range work is an ordinary galvanized iron pipe, thirty-five feet long, and about two and one-half inches in diameter on the roof of the laboratory with no wires whatever. Balboa used a simple home made receiver.

"Steps are being taken for experimental reception in the Hawaiian Islands and the Philippines. It is expected that extensive experimental work on high frequencies will be conducted during the coming fleet maneuvers. Despite the above results, high frequency work must be regarded as still in the experimental stage. It is a field offering wide possibilities, but much research is necessary before it can be definitely relied upon for long distance traffic."

MISCELLANEOUS

The Washington Experiment

By Sir Herbert Russell, *The Naval and Military Record*, 28 January, 1925.—Every age has had its great ideals, but it has remained for the United States to induce humanity to translate some of the oldest of these into definite action. The earlier civilization is probably less confident as

the result of longer and sterner experience. Men were talking about the folly of war before New England existed. Tennyson was writing about a league of nations (he did not use the precise phrase) when Woodrow Wilson was quite a youth. Plenty of earnest-minded people, lulled with the soothing influences of culture, have sought a way whereby the world might compose its quarrels without bloodshed and devastation, but their philosophy has never got beyond the ethical stage. Usually something has happened to dispel all beneficent dreams. The Tartars, the Vandals, the Huns, the Goths, or the Germans have swept idealism to the winds.

The United States thought it just about time for this to stop. She was getting on famously without war herself, and it took Germany nearly three years of pretty diligent effort to provoke her beyond endurance. President Wilson was a great idealist, but he was an American idealist. His vision was not clouded by many centuries of racial traditions. He saw things with a newness, if I may be permitted the expression, denied to the older civilization. He thought the war-weary world was ready for a change of heart; that at last human nature would radically reform, so he proposed the League of Nations.

Unfortunately for President Wilson, there were enough Irishmen, and Dagos, and Germans in the United States to effect the repudiation of his conception. The amazing thing is that while the earnest-minded men of other counutries flocked to the first definite lead ever given to their aspirations, the leader himself was disowned by his own land. Aloofness—which some regard as a synonym for presumptive superiority—was preached and easily won the day.

Quite undismayed by the possible effect of this curious anomaly upon the psychology of the older civilization, the United States shortly afterwards launched another ideal. President Harding invited the nations to meet in conference at Washington with a view to arriving at agreement upon the limitation of naval armaments. As the sentimental sincerity of the United States had come rather into question owing to her *volte* face in connection with the League of Nations, a good many sagacious people asked themselves just what was at the back of this new peaceful gesture. They then realized that America was burdened with a colossal program of naval construction. She had been very much nearer to hostilities with Japan than the world at large has ever known, but the menace had passed, and the colossal program was, therefore, no longer really necessary. In fact, it was assuming the aspect of a very expensive encumbrance. Moreover, there was an irritating directness in the question of how the United States expected to complement such a tremendous armada, since she was frankly finding it impossible to maintain an adequate manpower for her existent fleet—as she still is.

The juncture was singularly opportune for a conference upon the limitation of naval armaments. The world had been emancipated from any menace to the freedom of the seas. The very existence m such a colossal program of new construction put America in the position of being able to propose the conference with an air of benign concession. She had more than any other power to lose and nothing to gain by it. The simple fact that she was chiefly concerned to "save her face" was never even hinted at.

Well, the Washington Conference was held, and the whole of the naval world knows with what material results. The three principal sea powers—Great Britain, the United States, and Japan—professed to be well satisfied with the compromise arrived at, and ratified with little delay. France was a long time in affixing her signature, meanwhile openly protesting against the violation of the principle of self-determination and the sacrifice of prestige involved by allowing any other power, or powers, to dictate her

naval policy. Italy, in a less demonstrative fashion, followed a somewhat similar line. Incidentally, the principal plank in the Washington platform was the curbing of capital ship construction, and neither France nor Italy was building, nor contemplated building, any capital ship. This fact emphasizes the real character of their reluctance to ratify the Washington Treaty.

Japan attended in conciliatory mood. The United States was very propitiatory. Japan played conciliation with true Oriental subtlety. She acquiesced in the ratio of material strength proposed to her, perfectly well understanding that total tonnage is by no means the final standard of fighting efficiency, but she very successfully pressed her own claims to compensatory consideration. She carried her point to be permitted to complete and retain the 33,000-ton, 16-inch gunned *Mutsu*. She insisted that America should not further fortify the Philippines nor Guam, and that Great Britain should likewise abstain at Hongong. With assent to the development at Singapore we found no difficulty in acquiescing, because owing to its vulnerability to attack from the land, Hongkong might prove a costly place to hold in the one conceivable struggle which would render it of vital importance.

The conclusion of the Washington Conference left the United States complacent in the sence of successful achievement. It left Japan and ourselves fairly well satisfied; France and Italy in the frame of mind I have already indicated. I believe that there is no question as to the terms of the Washington Agreement having been loyally carried out by all the signatory powers. Where there is very real question it is as to the value of what the Washington Agreement has really achieved.

One point is abundantly clear: the experiment has failed in its primary object. It has limited the character of naval competition, but it has not checked it. Japan is building almost up to the normal capacity of her shipyards just the class of units which she would have elected to build had there been on international pact, because they are the class of units suited to her strategical purpose. We are building just what we think we need, and (with the exception of the *Nelson* and *Rodney*) that need would not have included capital ships in any case. It is true to say that France and Italy are doing likewise.

The United States is the one dissatisfied power. Probably in her desire to see fruition of the scheme of her own suggestion, she gave away more than she fully realized at the time. The prohibition with regard to the Pacific bases is a serious disability. Japan could take the Philippines with little difficulty, in the present condition of defense of these places, and none realzes this so clearly as Japan.

America set her own relative standard of naval strength. It was to be equivalent to our own, and in the ratio of 5-3 to that of Japan. She is now loudly complaining that she has failed to maintain her relative place, and is somewhat illogically blaming the Washington Treaty for her lapse in efficiency. Indeed, there is a big party in the United States at the present time openly advocating violation of the Washington Agreement as the simplest method of abrogating it altogether.

A pact which survives under such conditions, and which, moreover, has failed to accomplish the primary purpose of its conception, cannot long endure. This country accepted it because it offered definite economic relief at the time when there was no serious disadvantage accompanying restriction of sea armaments. Japan accepted it because she shrewdly foresaw that she was likely to gain more than she would lose—which, beyond question, she has done. America accepted it because she had proposed it, but it would be idle to pretend that the principle which under-

lies the Washington Agreement is altogether to the taste of the British people. Centuries of proud naval tradition have ingrained in them a profound sense of the right to their own unfettered opinions upon the subject of sea power. They know exactly what they have to guard: they claim to know better than any other nation how best to guard it. In fact, what they think, France, with her usual frankness, has openly said. The Washington Agreement is a characteristically American idea. It will probably lapse in a characteristically American fashion. Its passing would make no appreciable difference to the naval policy of this country, save that we should probably desist from the scrapping of any more perfectly serviceable warships, but so long as the treaty continues to exist, so long shall we be able to loyally conform to it without any menace to our position as the premier sea power of the world. The United States has apparently already made up her mind that she cannot go on subscribing to an arrangement—her own arrangement—under which she is steadily losing her relative position. That is her business. If she chooses to express the view that the great expirement has proved a great failure, the rest of the naval powers will probably merely agree with her.

British See War in Far East Likely, But in Distant Future

By Frank H. Simonds, Washington *Star*, 19 February, 1925.—London, February 19.—The danger of an American-Japanese conflict which bulked large at the time of my other visits to London in 1922-24, seems to have been generally discounted in recent months. Neither British official nor informed public opinion now anticipates any early explosion in the Far East either involving America, Great Britain or both countries.

No effort is made here to minimize the underlying seriousness of the Far Eastern situation. The drift of opinion, however, seems to be in the direction of a belief that there will be no aggressive Japanese action while peace is maintained in Europe, and as a subsidiary detail, while there is no grave development in India. On the other hand, it is equally appreciated here that Japanese sentiment remains bitter toward both America and England and is unlikely to change for the better, since there is no possibility of any modification of the attitude of the United States and of British dominion toward Japanese immigration.

To put the thing broadly, the British regard one of the outstanding dangers of the present world situation as a possible combination between Russia, Germany and Japan, and the recent treaty between Japan and Russia has occasioned much rather restrained comment. One hears in London a good deal more talk about the possible conflict between the yellow and white races than in America, or perhaps more exactly, than in the East of the United States.

Informed British opinion seems to be arriving at the conclusion that peace in the West may well insure temporary, if not permanent, peace in the East. By contrast, if one could conceive of another war in the West on the lines and expanding to the proportions of the last, then the common verdict is that the inevitable exhaustion of the white races would provide the East and Japan with an opportunity which would not be allowed to escape.

What stands out beyond all else is the British perception based upon intimate knowledge of and long continued experience with the East that what one might call the prestige of the West, of all white races, has been completely shattered by the World War and cannot be restored to anything like the old form. The consequence has been an enormous modification of the view of the East toward the West, which will continue to show itself in all directions.

But, so far as an American-Japanese conflict is concerned, the British do not believe Japan will attack the United States under present circumstances because they feel satisfied that the revelation of our industrial strength during the World War and the disclosure of the relative value of military and economic resources in the conflict have not been lost upon the Japanese mind. Granted these circumstances and assuming the practical impossibility of Japan dealing us any decisive or even crippling blow, the British dismiss such a struggle from the range of immediate possibilities.

In the same sense one hears much comment on the fact that the overthrow of the great German military machine and the complete failure of organized German military strength has had its lesson for Japan and has materially changed the Japanese estimate of the comparative importance of military strength.

Within the vast circles of its island barriers, British naval opinion holds that Japan is now impregnable, but in the same sense, with Singapore to be transferred into a great naval base, they regard Australian apprehensions as exaggerated. The notion that the Japanese fleet might venture beyond the circles of its own defenses and strike for Australia seems utterly improbable, and, what is reassuring, more likely to lead to Japanese disaster than success were it actually undertaken.

All of which is another way of saying that British opinion does not look for any Japanese explosion in the Far East for an appreciable time and does not fear anything that Japan might do now excessively. It believes that if it proves possible to arrive at an adjustment with Germany and an ultimate reappearance of Russia as a western power, the chief danger—namely, a division of white races—can be avoided.

Thus in examining the manifest efforts of British statesmen at the moment to bring about peace in Europe one must see, not alone a European, but an Asiatic purpose, and the British belief that both Germany and Russia must be permitted to resume possession of most, if not all, of what they lost in the East.

Yet it is clear that while the British do not expect any immediate explosion in the Far East, they are apprehensive that eventual conflict may be unavoidable, and they are equally convinced that the possible war will break out between America and Japan rather than between Japan and Britain. Looking to the long future, the British exepct the United States to develop as a Pacific power, that is to come gradually to have a growing policy of expansion in eastern markets.

Accepting now, as they largely do, the view that the United States will not join the League of Nations, associate itself with European affairs or even have any active European policy, they are more than ever convinced that we shall find ourselves drawn into eastern complications, pulled by the temptations of eastern markets, and in the end, perhaps committed to some more or less expansive policy in the Far East which will bring us in collision with Japan.

If such a collision took place, the British are satisfied that the pressure of their dominions, Canada, Australia and even South Africa, would make a belligerent of their own country, while they reason that if, on the other hand, the war came between Japan and themselves, we would be brought into the war by the demands of the people of our Pacific slopes, just as we were brought into the World War largely by the pressure of the people of the Atlantic seaboard.

And, in an odd but obvious fashion, British opinion, which has more or less completely abandoned the old idea of Anglo-American partnership in Europe, is coming to regard any such association as bound to come,

if at all, by reason of common dangers in Asia, and I do not think I exaggerate when I say they regard such association as inevitable.

At all events, and this is the point of main importance at the moment, the British discount all menace of American-Japanese conflict; at the moment public and official opinion has become far less pessimistic than one year or two years ago. It sees Japan faced with very great and absorbing problems in its immediate back yard and sobered immeasurably by the revelations of the World War itself in the matter of comparative values of military preparation and underlying economic resources.

All of which is not to say that the British are satisfied with the Pacific situation or the future prospects; it is not to disguise their conviction that we and the British dominions have given the Japanese an intolerable offense in our immigration policies; rather it is to affirm that while the Japanses resentment seems to them a permanent factor, and one which might eventually make war inescapable at a selected moment, that moment seems removed to a future sufficiently distant to permit concentration on other problems, with the added view that the solution of these problems, German and Russian, must have a tremendous effect upon the Asiatic situation.

Naval Construction in 1924

In spite of the criticisms which have been directed against the Washington Naval Treaty, notably in the country of its origin, there is no denying its effectiveness as a restraint upon heavy naval construction. Three year ago, when the treaty was under negotiation, capital ships to the number of thirty-four were building or on order for the three principal navies: viz., fifteen for the United States, fifteen for Japan, and four for Great Britain. As these vessels averaged at least 42,000 tons in displacement, they represented a total of about 1,428,000 tons. Moreover, the four British ships were but the first instalment of a program which aimed at rebuilding the fleet on a post-Jutland basis. It is certain, therefore, that but for the treaty there would not have been many more capital ships on the stocks in this country. As it is, the only such vessels under construction anywhere in the world today are two battleships for the British Navy, aggregating 70,000 tons. The contrast between this figure and that of December, 1921, affords striking proof of the efficacy of the treaty as a curb on battleship construction. In all other classes of naval tonnage the past year witnessed a marked revival of building activity. After a pause of six years, we laid down a batch of cruisers which are intended to replace the obsolete *County* class, long since scrapped. We also resumed the building of destroyers and submarines, albeit on a very moderate scale. Excepting a few submarines, the United States has no new construction in hand, nor is it probable that the eight 10,000-ton cruisers voted by Congress last month will be begun before 1926. Japan is working steadily on her program of light construction; France laid the keels of several ships authorized under the second half of the 1922 Navy Law, and Italy ordered two cruisers, besides many smaller craft. Most of the secondary naval powers are building ships of a type suited to their financial resources. Consequently, the number of new naval vessels in hand is fairly large, though their aggregate displacement may not seem imposing.

CURRENT NAVAL AND PROFESSIONAL PAPERS

"National Policies Toward Latin America." Lecture by Professor J. Q. Dealy of Brown University. *The Coast Artillery Journal*, January, 1925.

"Motor ships and Marine Oil Engines in 1924." *The Engineer*, 2 January, 1925.

"Combined Crankless Gas Engine and Gas Compressor." *Engineering*, 23 January, 1925.

The following interesting articles appear in the New Year Number of *The Shipbuilder*, January, 1925:

"Technical Progress during 1924 in Shipbuilding and Marine Engineering."

"Comparison of Model Propeller Experiments in Three Nations," by Rear Admiral D. W. Taylor, (CC), U.S.N. Rtd.

"The Resistance of Full Sized Ships," by John Tutin, M.Sc.

"Naval Construction in 1924." *The Engineer*, 2 January, 1925.

NOTES ON INTERNATIONAL AFFAIRS

PREPARED BY

PROFESSOR ALLAN WESTCOTT, U. S. NAVAL ACADEMY

FROM JANUARY 23 TO FEBRUARY 23

ENGLAND AND FRANCE

ENGLAND MAY WAIVE TWO THIRDS OF FRENCH DEBT.—The full text of Chancellor of the Exchequer Winston Churchill's reply to French Finance Minister Clementel outlining the British debt policy was published on February 8. The letter in effect made clear that Great Britain planned to ask from her European debtors only the fourteen billion gold marks she must pay America, and from this will deduct all reparations payments from Germany. It is calculated that, if the Dawes Plan works with complete success, England will receive about eight billion marks from Germany, leaving six billion to be paid by France and other European debtors. Of this France would be expected to shoulder more than half, or perhaps four billion marks; but this would be only about one third of her actual debt to Great Britain. In his note Mr. Churchill stated that payments from France might be in part based on French receipts from Germany, but that France would be expected also to pay a certain amount annually regardless of such receipts. It was expected that France would continue the negotiations in the near future.

GERMAN ARMAMENT REPORT PRESENTED.—The Report of the Allied Military Control Commission on armament conditions in Germany was presented in full on February 18. The report was of forty-one pages, with voluminous annexes setting forth technical respects in which Germany had failed to carry out the Versailles Treaty, including hiding of arms, failure to destroy munitions machinery, the German recruiting system, maintenance of police, and the German General Staff plan to use Germany's small army as skeleton of a larger military machine.

There was a divergence between France and Germany on the action to be taken in view of the report. England was believed to desire direct negotiations with Germany and, upon obtaining reasonable satisfaction, to evacuate Cologne and then discuss a security compact which should include Germany. France, on the other hand, preferred to publish this report in full to show that Germany was still a common menace to the Allied powers. France would not include Germany in a security agreement, or even consider such a step, until Germany had fully carried out the treaty obligations; and furthermore, France wished a security pact which would assure pro-

tection for Poland. An early conference on the subject between French and British officials was expected.

LEAGUE OF NATIONS

RESULTS OF OPIUM CONFERENCE.—The International Opium Conference ended on February 19 after more than three months of discussion. The conference was really divided in two bodies; the first, or Far Eastern Opium Conference, including only opium producing countries, and the second a larger conference in which Representative Stephen G. Porter, leading the United States delegation, was an active participant.

The Far Eastern Conference had earlier adopted an agreement to discontinue opium smoking in the Far East within fifteen years after China had effectively curbed over-production and smuggling, with a league commission to decide when a reasonable reduction in the growth of opium had been attained; and second, to abolish the farming system of opium traffic and substitute government monopolies.

In the general conference the American delegation fought hard to secure a decision for immediate reduction of opium production, but was opposed by the British and other delegations on the ground that nothing effective could be done until the Chinese Government was able to check over-production and smuggling. Subsequently, the American and also the Chinese delegations withdrew from the conference.

The convention as finally adopted consists of thirty-nine articles, with annexes, and according to the explanation issued "is calculated to complete and reinforce the Hague Convention by a series of measures destined to reduce the production and manufacture of narcotics and to tighten international control of the traffic." It was signed on the final day of the conference by delegates of ten nations, including Belgium, Great Britain, Japan, Greece and Holland. A central anti-narcotics board will be appointed by the League Council, with United States and Germany participating through representatives appointed for this sole purpose, its expenses to be included in the budget of the League Secretariat and paid according to a scale by the signatory powers.

BRITAIN DELAYS ACTION ON GENEVA PEACE PROTOCOL.—At the request of Great Britain, action by the League Council on the Geneva Peace Protocol was postponed from January until the meeting on March 9. In the meantime the British Government sought by correspondence to learn the attitude of the dominion governments on the question, and received replies from all except Ireland. The replies, although showing general sympathy with the aims of the protocol, expressed the belief that many of its provisions were hasty and ill-considered and that the ideal of peace should be aproached by gradual, practical stages. It was regarded as certain that the British Government would not sign the protocol without amendments, and that in any case the matter must go over until the League Assembly next September, making a June disarmament conference out of the question.

Criticism of the protocol in the Committee of Imperial Defense has been wide and destructive. Naval and military experts are understood to have raised the following objections:

That the protocol if left as it stands, makes an unlimited claim on Great Britain's resources, because the league may request action by the British naval and military forces in widely scattered areas without notice and to an unlimited extent; that the protocol would, therefore, prevent a reasonable performance by the War Departments of their duty to the country which is to develop plans of defense in certain foreseen emergencies; that the protocol in its present form gives advantage in time of war to an unscrupulous aggressor over an adversary who desires peace by the combersome peace machinery provided in document; that provisions of the protocol have a decided tendency toward limitations of the rights of national commanders, governments and parliaments over their own forces.

It has been pointed out that the protocol omits to mention the rights of national representative assemblies altogether. It also is urged that the protocol, far from contributing practically to abolition of war, directly recognizes war as an essential instrument in international relations and actually encourages it in the case, for instance, of a state which may desire to remain neutral and may be ordered to make war on another state closely united to it, perhaps not only by ties of friendship, but even by political and national ties as those which bind Great Britain and her dominions.

CONFERENCE ON MUNITIONS PRODUCTION CONTROL POSTPONED.—A special committee of the League Disarmament Commission, meeting at Geneva on February 17, decided that it would be unwise to call a conference on control of private manufacture of munitions until after the conference on traffic in munitions to be held next May. This was due chiefly to the view of the British delegation, supported by Japan, Italy and Sweden, that such a conference would be useless without the cooperation of the United States, and that constitutional provisions would prevent the United States from taking part in a conference intended to put munitions manufacture and export under state control. It was decided, however, that the committee in the meantime should act as a committee of study, and ask all governments, including the United States, as to constitutional or other obstacles to state supervision.

RUSSIA AND EASTERN EUROPE

TROTSKY EXPELLED AND PAPERS SEIZED.—Upon Leon Trotsky's departure for southern Russia on January 29, all his papers and notes were seized by order of the Soviet Central Committee. A decree was also issued dismissing Trotsky from his post as Commissar for the Army and Navy and appointing his former assistant as his successor.

ALLEGED SECRET CLAUSES IN RUSSO-JAPANESE PACT.—The German *Local Anzeiger* on January 14 published from a "hitherto very reliable source," alleged secret clauses of the Russo-Japanese treaty signed at Peking in January, the clauses providing that in case of English, American or French menace to China, Russia would put 200,000 men at China's disposal; that Japan should get all Saghalien in five years in return for giving Russia a fleet of cruisers, submarines, etc.; and that China's army should

be instructed exclusively by Russian and Japanese officers and should purchase its war materials from these two countries. Both the Japanese and Russian embassies in Berlin declared the story a pure invention.

GREECE PROTESTS EXPULSION OF PATRIARCH.—On February 11 the Greek Government sent a protest to the League of Nations against the order of Turkish authorities on January 30 expelling the Greek Patriarch and Archbishop, Mgr. Constantinos, from Constantinople. This was declared to be an infraction of the decision of the Mixed Committee on Exchanges of Greek and Turkish Populations, and a menace to the peaceful relations of the two countries.

The Turkish authorities took the ground that no violation of Turkish agreements was involved and that the Patriarch's functions were not affected by his removal. It was expected that a solution of the problem would be found at the meeting of the League Council in March.

UNITED STATES AND LATIN AMERICA

NEW NAVAL PARLEY BROACHED.—It was revealed in the British House of Commons on February 18, and confirmed in Washington, that American diplomatic representatives had engaged in informal conversations with British, French, Italian and Japanese officials regarding the possibility of another conference to extend the principle of limitation to all types of naval vessels. President Coolidge, however, was reported to be still of the opinion that a call for such a conference would not be opportune until after the success or failure of the plans for armament reduction initiated at Geneva.

WORLD UNRESPONSIVE TO ARMS PARLEY (Hector Bywater in Baltimore *Sun* of 15 February).—

That a second conference, whether held at Geneva or at Washington, will produce results as definite and as beneficial as those of the first, few political observers in this country believe. There would, of course, be less chance of a successful outcome if an attempt were made to regulate armaments of every description instead of naval strength alone, but even in the latter case there are serious obstacles in the way of success.

The very lack of enthusiasm manifested in France and Japan, and even in Great Britain, is an ominous sign. French opinion is almost solidly opposed to any further restriction being placed on the growth of the navy, because of the intimate connection between sea power and military defense. France is now forced to rely on African troops to bring her army up to war strength, and these troops could not be transported to Europe unless the sea routes were adequately guarded. It is to insure such protection that the big shipbuilding program was begun in 1922, and the French military authorities, who wield great influence, would stoutly oppose any reduction in the number of auxiliary craft now building or projected.

For Great Britain the naval problem resolves itself into a question of safeguarding seaborne commerce, upon which the country depends for its existence. As long as other powers maintain large auxiliary fleets capable of attacking her merchant ships she will consider herself bound to keep in service a strong force of cruisers and anti-submarine craft, and it is doubtful whether she would accept equality with the United States in these

types unless a ratio far in excess of American requirements were agreed to.

Since it is the American aim to achieve such equality, while at the same time avoiding further expenditure on new ships, there appears to be a fundamental conflict of interests between the two chief naval powers. To reconcile these interests might not be impossible, but it would certainly be difficult. We must assume, however, that the whole position will be carefully reviewed and all possible contingencies allowed for well in advance of the actual summoning of a conference.

The Japanese press for months past has been paying close attention to the question of disarmament, its attitude being one of qualified—very qualified—approval. Generally speaking the line of argument it takes is that the United States should set about creating "a peaceful atmosphere everywhere" before submitting any further plan of limitation.

The Tokio *Asahi* points to the anti-Japanese legislation of last year as the sort of thing that is best calculated to make Japan set her face like flint against fresh proposals for naval reduction. "It would be an act of inconsistency," the journal adds, "for the American Congress to suggest another disarmament conference, on the one hand, and to pass the Japanese exclusion bill on the other."

The *Kokumin* argues that the deficit in Japanese naval strength caused by her acceptance of the 5-5-3 ratio in heavy ships must be made up in other ways, and it concludes significantly:

"That the Japanese delegates did not publicly announce their opposition to the Hughes proposal for restricting subsidiary vessels is no proof of Japan's acceptance of his plan. Since then, moreover, the general situation in the world has witnessed gradual changes, and there is even a danger of a serious change coming over the Far Eastern situation in future. It is, in such circumstances, absolutely impossible for Japan to submit to the same ratio as the Hughes plan provided for the limitation of subsidiary craft."

Count Soeshima, who has written frequently and ably on Japan-American relations, is unsympathetic toward the idea of a new naval conference, evidently because he has taken America's exclusionist policy very much to heart. After complaining that even at the first conference Japan was treated as a delinquent, he declares that her position would be far worse at a second parley, "for the obvious reason that there is all the difference in the world between the strength of this country in 1921 and at present. Japan had then a powerful fleet that was the dread of the powers. Her specie holdings exceeded two billion yen. The Anglo-Japanese alliance was still in existence. In fact, she was one of the three great powers of the world, while the others had not yet recovered from their war wounds.

"But what is the state of our country now?" he asks. " Despite the loan raised in America at a high rate, our specie has decreased to two thirds of the former figure and the earthquake has destroyed one tenth of our national wealth. It is to be feared that another international conference held at the instance of self-willed America may work incalculable disadvantage to the country. Japan herself should, therefore, invite the powers to a great conference in Tokio and preside over discussion of the questions of the abolition of race discrimination, respect for the integrity of China and for the vested interests of the powers in that country, and also the questions of opium and disarmament."

These are the words, not of a militarist or a jingo, but of one who was until recently a fervent advocate of friendship with the United States.

The *Jiji*, like other Japanese papers, points to the absence of any improvement in the situation which three years ago wrecked the Hughes Plan for rationing auxiliary fleets. Since conditions today are virtually the

same, it sees no reason to hope for a solution of the problem which proved so baffling at that time.

"Although Japan is in favor of limitation in principle, she could only consent to it on terms," we are warned. "At present her strength in auxiliary craft, particularly submarines, is far below that of Britain, France and America, and there would be a danger of Japanese submarine strength being reduced to *nil* if unfavorable terms were agreed upon. For a country of limited financial means it is most imperative that her submarine power should be augmented so as to forbid the approach of hostile squadrons to her long coastline. All other powers also have their peculiar national conditions which make it difficult for them to accept such limitation. Not until these difficulties are removed can a new naval conference be profitably and successfully staged."

In fact, the *Jiji* does not think that America, realizing how failure would hurt her prestige, will venture to call a conference unless fully assured of its success.

What Viscount Kato, the premier, thinks of the matter has yet to be disclosed, though he was less reticent when the first conference was impending, being then without ministerial responsibility. In August, 1921, he expressed doubt as to whether America was "really sincere and in earnest in advocating the limitation of armaments."

"It is conceivable," he said, "that religionists and others in America, who have been loud in their advocacy of disarmament, moved their government to draft the present proposal."

But if a discreet silence reigns in official circles, the tone of the whole press is indicative of Japan's reluctance to engage in negotiations for the further pruning of her armaments. French sentiment is no more cordial, while even in Great Britain the question of a new arms compact is not treated as if it were really urgent or immediately desirable. Whether this lack of responsiveness abroad will discourage Senator Borah remains to be seen. It is possible that the difficulties outlined in the foregoing are less formidable than they seem. From this side of the ocean, however, they appear well-nigh insuperable.

NEW JAPANESE AMBASSADOR.—Ambassador Matsudaira, new Japanese envoy to the United States, left Tokio for Washington on February 16. The Ambassador was formerly Vice-Minister of Foreign Affairs under Baron Shidehara.

GERMAN COMMERCIAL TREATY RATIFIED.—On February 10 the United States Senate ratified with reservations the commercial treaty recently negotiated between the United States and Germany. Th chief reservation stipulated that nothing in the treaty should be interpreted to affect existing immigration laws, or the right of either country to enact such statutes. This is Germany's first long-time agreement with a former opponent. It will be taken up by the Reichstag Foreign Affairs Committee before its ratification is considered by the Reichstag.

NEW CHILEAN GOVERNMENT.—After four months in power, the military Junta that ousted President Arturo Alessandri in Chili was itself overthrown at the close of January by an organization of younger military officers. At the invitation of the new group, President Alessandri decided to return to Chili. A cabinet was formed headed by members of his party.

BOOK REVIEWS

A STUDY OF WAR—By Admiral Sir Reginald Custance, R.N., G.C.B., K.C.M.G., C.V.O. Constable and Company, Ltd. London, Bombay, Sydney. 12s. Houghton, Mifflin and Company, Boston and New York. $3.50.

REVIEWED BY REAR ADMIRAL C. F. GOODRICH, U. S. NAVY, RETIRED

The author of *"Naval Policy," "The Ship of the Line in Battle,"* and *"War at Sea,"* has just given us another product of his fertile brain. It is based on profound research and the skilful use of unquestionably accurate data. The mental grasp is manifest on every page, as is the discarding of nonessentials and the going straight to the root of the problem attacked.

Sir Reginald's conclusion, which cannot well be challenged, is that in every war, two schools of thought are found—the political and the military—which are so often in opposition as to block each other's efforts and thus render complete success impossible. The one seeks to secure important concessions or to conquer territory, the other to defeat the enemy's forces in the field or his fleets on the seas. The latter course is the only one which leads to enduring results. "It cannot be too often stated," he remarks in his concluding sentence, "that the primary military aim of the navy, army and aery is to destroy or neutralize the enemy armed force in order to obtain the political object, security."

Too often, one might almost say, invariably, war offices and admiralties put the cart before the horse, sacrificing proper use of military or naval power to what should be secondary—safety. Our Civil War, our war with Spain and our World War furnish many illuminating examples of this mistaken practice on our own part. Victory alone can effect the latter and bring about lasting peace.

To this decision, Sir Reginald is brought by his careful analysis of all the principal wars from the earliest to the latest times. His criticism of the neglect of this fundamental and dominating factor in the World War is especially worth consideration.

To enter into an elaborate review of this brief but pertinent work by an acknowledged authority would spoil the pleasure of its reading. It may be rightly held that all of our officers should study it in order to get a correct view of how our fleets should be employed. This obligation is particularly incumbent on those who, occupying important positions at Washington, may, at any moment, be called upon to aid in formulating a correct policy founded on the teachings of all naval history.

Under the modest title of *A Study of War*, the author has actually evolved a system of war philosophy of which we all ought to be disciples.

REVIEWED BY REAR ADMIRAL W. L. RODGERS, U. S. NAVY, RETIRED

This very interesting work points out the relation of a country's supreme government to its combatant agencies in the prosecution of war. It is worthy of study by the general public, as well as by the navy, for its historical examples are clearly and convincingly narrated, and those familiar with the principles set forth are less likely than others to make undue and unwise demands upon the army and navy for the defense of the country.

In brief, the writer holds that any nation enters a war with some political objective in view which it proposes to attain through some appropriate line of combatant action. He asserts that there is a proper connection between the political objective and the military aim which is unvarying through the centuries and independent of the nature of weapons and of the stage of the arts and sciences. His doctrine is that the military aim should be to destroy the hostile armed forces, and that when the rulers responsible for the conduct of the war attempt, for that goal, to substitute the direct attainment of some political objective, they have no right to expect an early or successful termination of the war. To quote the author's own words:

To ward off attack is a military aim; to make secure is a political object. The military aim, battle, and the political object, security, are confused together, with the result that the lay mind concentrates on the thing to be defended and loses sight of the enemy armed force which threatens. Hence the tendency to wait attack and to multiply defenses in every conceivable direction. It cannot be too often stated that the primary military aim of the army, navy and aery is to destroy, or to neutralize the enemy armed force in order to obtain the political object, security.

The author says in his preface that he attempts to set forth and illustrate a theory of war. For the German doctrine of the so-called "will to power," he substitutes the British doctrine of the "will to security." In form, the German doctrine is aggressive and the British is defensive. The latter is the one with which we in this country more readily sympathize, for it justifies such a degree of preparation as our legislature chooses to purchase. But, as we proceed further in the book, the difference between the German "will to power" and the British "will to security" seems perhaps to be less than the author supposes. He says:

In every war, the question at issue is some real or imaginary right, varying in importance, upon which the security of each nation or its interests is thought to depend in varying degree. Hence, security may be said in general terms to be the national or political object.

So the German "will to power" seems to be that form of the "will to security" which anticipates possible quarrel by striking down a prospective contestant before the point of rivalry has clearly defined itself to the latter. Both doctrines express the instinctive selfish desires for life and liberty

which are the bases of the existence of men and nations; but the German form is more odious in its aspect to on-looking third parties, while the British form is an admitted right of nations.

With much skill, the author sketches the outlines of a number of wars to show that nations with opposing policies, having committed themselves to hostilities to obtain security for threatened political objectives, have then too often allowed their military effort to be turned toward passive defense rather than toward aggressive battle.

Sir Reginald Custance goes on to amplify his doctrine, and while continuing to maintain that successful battle is the decisive act of war from which national security is derived, he admits that a contributive or secondary aim for each of the two contending hosts is to weaken the armed force of its opponent and relatively strengthen its own by operating against the material resources and morale upon which the enemy's resistance is founded. It is here, perhaps, that ground may be found for dissent from the author's theory of war. He states very clearly, and illustrates by many convincing examples that complete success for the political objective is not to be attained until the hostile armed forces are no longer capable of resistance: but his conclusion that battle is invariably necessary to defeat the army, he does not make entirely irrefutable.

He undoubtedly demonstrates that frequently the civil heads of government and sometimes the military commanders are too much concerned with security for political objectives and pay insufficient attention to the destruction of the hostile armed forces which menace security. In a word, military leaders should withstand the tendency of the supreme civil head to occupy the combatant forces with problems of defense rather than of attack, but, unfortunately, the former too often adopt the untechnical point of view under pressure of which only the greatest personalities are able to overcome.

On the other hand, it may be disputed whether the author's classification of battle as the primary means of attack, and operations against resources as the secondary means, should be accepted without some qualification. As an alternative proposition it may be said that in all wars, whether private between individuals, or public between nations, there may be direct attack on the life of the opponent by bloodshed, or an indirect attack thereon by destruction of his means of livelihood. When successful, the first method is quicker than the other, but no more conclusive. An opponent may refuse battle, but a strong attack on his means of subsistence obliges him, in the end, either to accept battle or seek surrender.

When the author takes up the rôle of navies in war, he dwells particularly on the propriety and advantage of battle to destroy the hostile naval forces in order to command the sea as the reward of victory. It appears to this reviewer that although the author's conclusions are sound, the steps by which he arrives at them are not altogether sequent, and that he assimilates too much the specific missions of armies and of navies. The results of all wars bear their fruits on the land where men live and whence they derive

their sustenance. The object of war is, therefore, the control of territory and the subjugation of the in-dwelling population to the will of the victor. At the close of the war, the terms of peace usually arrange the conditions upon which the free will or sovereignty of the defeated nation is restored to it. The occupation of land and the economic control of its population is then the ultimate military aim. This end can be reached by driving back the defending army, either by battle, or by cutting it off from its material and moral resources and supports which are the bases of its active opposition. The German Army in the late war seems to have suffered more from the shortage of the material recources behind it and from loss of aggressive spirit by the people at home than from the formal ability to keep the field. The German Army retreated before the tactical blows of the Allied field armies because the economic attack by the Allied fleets on the German resources was effective. In this case, the military aim, occupation of the Rhine Valley, was accomplished unopposed after the Armistice by success in the economic strife, which was as bitter as that on the fields of Flanders.

It seems incorrect, therefore, to adjudge battle the sole and supreme arbiter of war, for it was not so in the last war. It is the preservation of the aggressive spirit and of the attacking initiative which brings success. However, it cannot be denied that the attack on resources usually forces the enemy to battle, which, if conclusive, forbids further resistance and is the final act of the contest.

It is then passive defense which usually fails a nation, and as Admiral Custance points out with much felicity, it is the untechnical attempt to retain security without aggressive efforts which is too often responsible for miscarriage in war.[1]

In discussing naval operations it will be seen that their effect on the outcome of the war is different from that of armies. The sea is not the abode of man but merely his highway. The supreme object of naval exertion, therefore, is always the indirect form of attack through stopping the enemy's transportation and thereby cutting off his resources. With justice, Admiral Custance condemns the defensive naval attitude, concerned only in safeguarding one's own ocean traffic, and he says truly that successful fleet action is the most certain way of protecting one's own resources and reducing those of the enemy, but if he means, as apparently he does, that fleet battle is the final aim of naval warfare, his view may properly be contested. The final end of naval warfare is control of seaborne commerce in favor of oneself and in restraint of the enemy. On this point Admiral Custance disputes certain of Mahan's dicta, but in reading the quotations, it appears to this reviewer that he finds unnecessary fault with Mahan. The latter's views are not really divergent from those of the former.

[1] The report of the General Board of the Navy to the Secretary under date of January 17, 1925, and published by H. R. Naval Committee (No. 69) deals with this subject and the employment of navies and is worth comparing with the book here under review.

At the close of the chapter on Strategy, pp. 106-108, the author offers the conceptions of several writers as to the duties of navies in war and then summarizes his whole doctrine as follows:

The military aim is (1) To destroy or neutralize the enemy's armed forces and thus to protect our own seaborne trade, military transports and supply ships, and (2) To stop enemy seaborne trade, military transports and supply ships.

The whole tendency of the book is to set forth Clausewitz' dogma that aggression wins and that passive defense as a permanent policy gets nothing; but what the author formally states is that battle is the chief or principal form of contest and that war against resources is secondary.

An interpolation upon the general lines of the book is the chapter on Navy, Army and Aery, which is of present interest here in the United States on account of the current controversy as to the status of the air service and offers a British opinion as to the best organization. The writer holds that:

The separate Air Ministry was created during the war without any regard to the military relations between the navy, army and aery, which were not then understood. Its creation was brought about chiefly by temporary difficulties of supply, which are not matters to govern the organization of an armed force. That Ministry controlled a small independent air force, but acted mainly as a supply department to the navy and army, who used the air force to reinforce their own efforts by sea and land.

It seems to be generally held in England that the entrenched strength of vested interests in the Air Service is the chief obstacle to placing the control of the administration of the combatant branches of the English Air Service entirely in the hands of the Admiralty and War Office, respectively.

It would be a great misfortune if Congress should be misled by the romance of the air to imitate the British mistake.[2]

This work of Admiral Custance is one whose every part well repays close study by army and navy as well as by civilians interested in problems of government. It is to be hoped that the Navy Department may provide ships' libraries with copies.

INTERACTION BETWEEN VESSELS, By R. B. Bodilly, Commander, R. N., BARRISTER at LAW. D. Van Nostrand Co., London and New York. 1924. 132 pages. $3.50.

Reviewed by Rear Admiral D. W. Taylor (CC), U. S. Navy, Ret.

This work comprises 132 pages divided into seven chapters and fifteen figures. The author is both a naval officer and a lawyer—not a usual

[2] See above mentioned report of General Board on this point, also.

combination—and his work is largely from the point of view of the lawyer, though it deals with the physical, not the legal, aspects of collisions. About fifty pages are devoted to the *Olympic-Hawke* collision as brought out in court in 1911. This was the first case before a British court where "suction," as it is commonly called in the United States, was claimed and the judge having decided that an irresistible hydraulic interaction was present the author naturally devotes much space to the theories and evidence of the various experts and others who testified. In United States courts suction is a much older story. Collisions in the shallow, narrow and crowded channels of our Great Lakes seem to have resulted in a number of important cases in court where suction was claimed by one side or the other.

To the naval officer this book presents a sound theory and description of the phenomena of suction which are of professional interest and value. The mathematical minded might complain that it is frequently attempted to convey by words ideas more simply and adequately expressed by mathematical methods. The practical minded might complain that the author does not specify definitely with metes and bounds the danger area. This, however, is impossible in the present state of knowledge. Too many factors are involved and at present it is necessary to deal qualitatively rather than quantitatively with them. This the author has done in an adequate manner, dealing specifically and in some detail with the four natural classes of cases: namely, vessels meeting and passing in open deep water and in shallow narrow waters.

His three safety rules may be expressed as follows: go slowly; use helm cautiously; keep away the length of the largest vessel when passing. These are sound but the latter cannot always be followed in confined waters.

In his laudable attempt to avoid mathematics the author, while by no means ignoring it, has not laid as much stress as he might upon the basic physical fact to which suction is due. Some hundreds of years ago Bernouilli developed his theorem that in a steady stream of varying area, and hence velocity, the higher the velocity the lower the pressure and vice versa. Thus, in a level pipe of gently varying section flowing full the pressure is least at the smallest section where the velocity is greatest. This does not seem altogether natural but is a fact that has been demonstrated repeatedly by experiment since Bernouilli's time.

Applied to two ships abreast and close to each other, the channel, if it may be so called, between them is restricted, the water that must flow aft flows faster between them than on the free sides and there is reduction of pressure which, on a given ship, may be concentrated forward or aft according to her relative angle and hence suction may tend to sheer bow or stern in, for comparatively small initial departure from the parallel position. Collisions caused by suction are not due to the bodily pull but to the sometimes violent sheer caused by pull concentrated forward or aft. While Bernouilli's Theorem is not often demonstrated by collisions of vessels there are plenty of practical illustrations of it.

A recent one is the Flettner sail—a large cylinder something like an exaggerated revolving smokestack—which acts effectively to draw its ships ahead. Roughly, its action is as follows. Suppose the wind is on the starboard beam. The cylinder is revolved counter clockwise looking down on it. This causes the air to divide unequally, more air passing forward of the cylinder than astern of it. The excess air forward must move faster past the cylinder than the air astern. There is a corresponding reduction of pressure forward or a suction drawing the ship ahead.

The curve of a baseball is due to precisely the same action. A baseball pitched with a twist or spin will always curve "following its nose." Suppose, for instance, that looking down upon it from above the pitcher the twist is about a vertical axis and clockwise. The nose is moving to the right. That causes more air to pass to the right and the baseball curves bodily to the right—an in-curve for a right-handed batsman.

It would seem that "interaction between vessels" is one subject which officers responsible for handling vessels should *not* learn by practical experience. A little learning thus attained is liable to be a very dangerous thing. Commander Bodilly's work must be studied to be understood, but careful study may enable its student to avoid some painful, practical experience.

JANE'S FIGHTING SHIPS, 1924. Edited by Oscar Parks, O.B.E., M.B., Ch.B., and Francis E. McMurtrie, A.I.N.A. Published by Sampson Low, Marston and Company, Ltd., London. 424 pages. $12.60.

Jane's Fighting Ships, 1924, is the latest edition of this excellent publication, which for so many years has been so important a work of reference on the navies of the world. This, the twenty-seventh annual issue, is fully up to the standard of its predecessors, and, like the issue immediately preceding, was gotten out under the joint editorship of Dr. Oscar Parkes and Francis E. McMurtrie.

No radical changes, either in form or arrangement of material, are observable. The present edition is somewhat larger than that of 1923, due in part to new material, including some excellent photographs, and in part to the reinstatement by request of the particulars of Japanese and American harbors, docks and shipbuilding resources, which have been omitted in recent years. The number of ships deleted, either through obsolescence or as a result of the Limitation of Armament Treaty, is necessarily small. The treatment of aircraft carriers has been extended, and in all types of war craft numerous blank spaces have been filled and data heretofore missing have been supplied.

Much interest will attach to the new plans for the 10,000-ton cruisers. Those listed in the present volume are as follows:

British. *County* class, five ships (no details given).

Japanese. *Nachi* class, four ships. Twelve 8-inch, 50 caliber guns; 12

tubes; 33.5 knots; radius at 15 knots, 14,000 miles; triple hull; vertical and deck protection over boiler and machinery spaces; carries four sea-planes.

Italian. Trento class, four ships. Eight 8-inch 50 caliber guns; 4 tubes; 34 knots; will carry two scouting sea-planes, equipped for bombing.

French. Tourville class, six ships. Eight 8-inch guns; 6 tubes; 33 knots; radius at 15 knots, 4,500 miles; carries four scouting sea-planes and launching catapults.

Upon these designs the editors of *Jane* comment as follows:

Amongst the new plans which have not been published previously are those of the new French and Italian 10,000-ton cruisers. It will be seen that the latter mount eight 8-inch guns, and not ten, as has been generally stated, and that in general the two designs present characteristics which in all probability will be common to the British and U. S. A. designs. Tentative designs for the U. S. cruisers showed an armament for twelve 8-inch guns in triple mountings, with corresponding sacrifices elsewhere and a very similar design is reported to have been adopted by Japan, but as it is generally conceded that Italian designers can get as much, or more, out of a ton of displacement than can anyone else, it is possible that too great sacrifices have been in structural strength, fuel and ammunition supply, or other qualities which can be compromised.

Altogether the 1924 *Jane* reflects much credit upon the editors and publishers. It will be a welcome addition to every naval library.

H. G. S. W.

ROLL AND GO. Songs of American Sailormen. Compiled by Joanna C. Colcord with an Introduction by Lincoln Colcord. The Bobbs-Merrill Company, Indianapolis. 130 pages. $5.00.

"In the old days when American sailing ships still ploughed the seas," says the compiler, "it was the custom of their sailors to enliven both their work and their leisure time with song. . . . These songs of the sea have in every line of their verses and every bar of their music the distinctive flavor of seafaring. . . . Practically all of the shanties to follow in this book (all sung on board ship as late as the '90's in some form) can be traced in their origins farther back than 1850." *Roll and Go* is a compilation of these "shanties," or "chanties" of the sea—an almost forgotten relic of the days when the Yankee clipper ship, unmatched in speed or beauty, was the envy and admiration of all who sailed the seas.

The origin of the word "shanty" or "chantey" is obscure, both forms being authorized. Whether from the French "chanter" as some maintain, or named after the waterfront "shanties" whence came many of those who originated the songs, it has been adopted in the language of the sea. The compiler throughout sticks to the form "shanty," not because she prefers it, but that landsmen may not mispronounce the word, thereby sending "a shudder down every seaman's spine."

As different types of shanties were suited to different occupations, so

the compiler has chosen to classify them along those lines, both words and music being given. The following are the groups used:

I. Short-Drag Shanties.
II. Halyard Shanties.
III. Windlass or Capstan Shanties.
IV. Forecastle Songs.

There are perhaps eighty in all. Among the collection will be found such well-known favorites as "High Barbaree," "Blow a Man Down" (three versions), "Early in the Morning" and "Captain Kidd," besides many others whose words and whose tunes have long since been forgotten save by a few. The comments on the individual shanties have been arranged in the form of a running text, which is not only readable but entertaining. The book is attractively gotten up, the illustrations being largely reproductions of paintings and engravings of famous old American clippers.

It is well that such a compilation should be made before it is too late, and fortunate that the task could be undertaken by one who has a background of the sea. Descended from five generations of deep water seamen, born at sea in the cabin of a sailing ship, and having spent most of her girlhood, up to the age of eighteen, at sea, on voyages to and from the China coast, on a sailing vessel of which her father was master, the compiler has brought to the task an experience such as few can equal. It is obvious to the reader that the task has been a labor of love.

H. G. S. W.

COMBUSTION IN THE POWER PLANT—By Thomas A. Marsh, M.E. Van Nostrand Company, New York, 1924. Price $2.00.

The scientific burning of coal is practiced by combustion engineers but Mr. Marsh prefers to call them "coal-burners." This is proper because it addresses the subject to a larger following and at the same time places responsibility upon many of the employees of the power plant, as their common problem is that of low ultimate cost of production.

The book begins with a short historical sketch followed by a classification of the coals in accordance with their geological origin and then by provinces in the United States. This is, unfortunately, followed at this place by a detailed discussion of the coal market, by states. The coal-burner may find it difficult to wade through all of this section without losing interest. I believe it would have been better if the author had taken up some general cases and then referred to the accumulated data at the end of the book.

After he has discussed the United States and the foreign coals, the author lists items influencing selection of coal under the following headings:

1. Ability to carry the plant load.
2. Reliability of supply.

3. Mine equipment.
4. Mine preparation.
5. Ability of producer to give uniform quality.
6. Transportation facilities.
7. Adaptability to stoking equipment.
8. Service (engineering assistance from coal company).
9. Storage properties of coal.
10. Boiler capacity obtainable.
11. Maintenance costs of furnaces and stokers.
12. Fusion temperature of the ash.
13. Labor of firing.
14. Responsiveness to meet sudden load demands.
15. Smokelessness.
16. Cost of ash removal.
17. Sulphur content.

The relative importance of each item is well brought out.

An unusual treatment of the subject of combustion is given with the omission of the usual chemical equations, so meaningless to the layman.

Proper emphasis of the importance of operation has been made with the use of numerical illustrations. The author states, also, that the physical condition of the plant is a leading factor. He suggests methods for successful operation and gives a motto of "clean and tight."

Although the book is primarily for shore coal-burners, seagoing coal-burners will find much of interest in the book—not the least of which will be Table XIV in which are tabulated the causes and remedies for various trouble investigations.

C. P. B.

LES FLOTTES DE COMBAT, 1925; one volume in 16, oblong, limp cloth binding. Société d'Editions Geographiques, Maritimes et Coloniales, 17, rue Jacob, Paris, France. 25 francs.

The publication of *Les Flottes de Combat*, by Commandant de Balincourt, which was interrupted in 1917, has been continued again for 1925 by the assistance of the general staff of the French Navy.

This book is the French counterpart of Jane's *Fighting Ships*. An agreeable feature is the use of drawings in two colors, in which a steel blue tint is used to show the armored or protective portions of ships' hulls instead of the usual hatching. The work is very well gotten up in a handy form and at a reasonable price.

Those who knew the earlier editions of this work will welcome its reappearance.

SECRETARY'S NOTES

Membership

Present Membership, 4211. Changes since last report: New Members, 8. Resignations, 6. Deaths, 2. Dropped, 1. Total Decrease, 1.

New members joining since last report:

Kidd, A. C., Lieut., U.S.N.
Flanigan, H. A., Lieut. Comdr., U.S.N.
Gladden, A. A., Lieut., U.S.M.C.
Landon, N. E., Captain, U.S.M.C.
Rickover, H. G., Ens., U.S.N.
Wagner, Harry, Midn., U.S.N.
Reis, Raul
Tracy, O. V.

Resignation from Board of Control

The resignation of Lieutenant Commander M. S. Tisdale, U. S. Navy, as a member of the Board of Control, due to detachment from the Naval Academy, was accepted with great regret. Lieutenant Commander W. G. Greenman, U. S. Navy, was elected to succeed Lieutenant Commander Tisdale.

The Secretary has received from the Directeur of the French "Conservatoire National des Arts et Métiers" ten copies of the rules governing the reception of exhibits for entry in the "Permanent Exposition of Life-Saving Apparatus" (Anthony Pollok prize). This is a prize open to international competition for the best new apparatus for life-saving at sea, which is awarded at intervals by a committee, on which the United States and Great Britain, among others, are particularly represented. The exposition itself is a permanent affair, conducted under the auspices of the French "Conservatoire National des Arts et Métiers," in Paris.

The Secretary will be glad to send a copy of these rules to anyone who may be interested.

Articles

The Institute desires articles of interest to all branches of the service, including the reserve force. Non-members as well as members may submit articles, and authors receive due compensation for articles published. Compact, well digested articles are more likely to be accepted for early publication. In accepting articles for publication, the Institute reserves the right to have such articles revised or rearranged,

where necessary, in order to bring them up to the required standard of articles published in the PROCEEDINGS—the cost, if any, to be deducted from the compensation due the author.

Reprints of Articles Twenty copies of reprints are furnished authors free of charge. Additional copies to the number desired will be furnished at author's expense, provided request is made before going to press.

Discussions Discussion of articles published in the PROCEEDINGS is cordially invited. Discussions accepted for publication are paid for at approximately one-half the rate for original articles.

Book Reviews As soon as practicable after the publication of books on subjects of professional interest, the Institute aims to publish authoritative reviews of them.

Address of Members In the past, many errors have resulted from the habit of changing an officer's address as soon as his transfer orders are published in the papers. No change will be made in the future except upon receipt of notification by the member concerned. Reliance upon the former method may, in extreme cases, mean a delay of almost four months. To insure the prompt delivery of the PROCEEDINGS and other communications from the U. S. Naval Institute, it is essential that members and subscribers *notify the Secretary-Treasurer without delay of every change of address.* No responsibility can be accepted for failure to receive the PROCEEDINGS, where members fail to comply with this rule. Changes of address should reach the Institute by the 25th of the month, to be effective for the issue of the PROCEEDINGS of the following month.

Coupons for Applications For the convenience of members making application for membership or for subscription, or informing the Institute of changes of address, a number of blank forms will be found elsewhere in this issue. It is hoped that members will take full advantage of these in order to reduce clerical work of all concerned.

H. A. BALDRIDGE,
Captain, U. S. Navy, Secretary-Treasurer.

ANNUAL FINANCIAL STATEMENT

UNITED STATES NAVAL INSTITUTE,
ANNAPOLIS, MARYLAND.

AUDITORS' REPORT FOR THE YEAR ENDED DECEMBER 31, 1924

To the Officers and Members
of the United States Naval Institute,
Annapolis, Maryland.

Gentlemen:

We have audited the books of the UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MARYLAND, for the year ended DECEMBER 31, 1924, and submit herewith a certificate and the following exhibits and schedules:

EXHIBIT A—BALANCE SHEET as of DECEMBER 31, 1924.

SCHEDULE No. 1.—STATEMENT of CASH RECEIPTS and DISBURSEMENTS for the year ended DECEMBER 31, 1924. [*Not published here*]

SCHEDULE No. 2.—BONDS at COST. [*Not published here*]

SCHEDULE No. 3.—ACCOUNTS PAYABLE. [*Not published here*]

SCHEDULE No. 4.—SURPLUS [*Not published here*] all as of DECEMBER 31, 1924.

EXHIBIT B—STATEMENT of PROFIT and LOSS for the year ended DECEMBER 31, 1924.

EXHIBIT C—COMPARATIVE BALANCE SHEET DECEMBER 31, 1923—DECEMBER 31, 1924, and [*Abbreviated*]

EXHIBIT D—COMPARATIVE STATEMENT of PROFIT and LOSS for the two years ended DECEMBER 31, 1923—DECEMBER 31, 1924. [*Abbreviated*]

We have satisfied ourselves as to the correctness of the inventory.

The condition of the books, papers, records, etc., was such as to merit commendation.

CERTIFICATE

WE HAVE AUDITED the books of the UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MARYLAND, for the year ended DECEMBER 31, 1924, and

WE HEREBY CERTIFY that the accompanying BALANCE SHEET and STATEMENT of INCOME and EXPENSES are correct; and in our opinion clearly set forth the true financial condition as of DECEMBER 31, 1924, and result of operations for the year ended DECEMBER 31, 1924, respectively.

BLACK and COMPANY
CERTIFIED PUBLIC ACCOUNTANTS.
By: WILMER BLACK, C.P.A.

MEMBER
(American Society of Certified Public Accountants)
(Maryland Association of Certified Public Accountants)
Baltimore, Maryland.
January Thirtieth,
Nineteen Hundred and Twenty-five.

REMARKS OF SECRETARY-TREASURER

In accordance with the Constitution adopted at the annual meeting, the special reserve fund to guarantee the interests of life members has been discontinued, the amount having been transferred to surplus.

The fund "Contingent Profits" is a reserve established to cover the probable loss due to unsalable remainders of editions of books published by the Institute. For the purpose of comparison with previous years, the amount of this fund, viz., $6,728.97, should be added to the net profit for the year of $3,454.25, making a total of $10,183.22. As there is nearly always an unsalable remainder of each book published, which remainder is frequently of material size and in some cases more than half the edition, the carrying of this reserve "Contingent Profits" presents a better picture of the financial conditions of the Institute and of its operation during the year.

H. G. S. WALLACE,
COMMANDER, U. S. NAVY,
Secretary-Treasurer.

EXHIBIT A

Balance Sheet — **December 31, 1924**

ASSETS

CASH in Bank				$ 38,576.76	
ACCOUNTS RECEIVABLE					
Dues in arrears	$3,320.51				
Less: Reserve	1,500.00	$1,820.51			
From Advertisers	$ 281.99				
Less: Reserve	70.17	211.82			
From Book Sales	$5,253.85				
Less: Reserve	107.39	5,146.46	$ 7,178.79		
INTEREST ACCRUED			2,025.79		
Total Receivables			9,204.58	9,204.58	
OTHER ASSETS					
Bonds at Cost				116,165.84	
Inventory					
Books			$40,779.28		
Office Supplies			860.70		
			$41,639.98		
Less: Reserve			8,000.00	33,639.98	
FURNITURE and FIXTURES				2,051.93	
PREPAYMENTS					
Royalty			495.64		
Expenses			117.09	612.73	
				$200,251.82	$200,251.82

LIABILITIES

ACCOUNTS PAYABLE		
Various Dealers		$ 6,362.40
Accrued Royalty		214.84
		$ 6,577.24
DEFERRED CREDITS		
Contingent Profits		6,728.97
PREPAYMENTS		
Dues to Members	$5,062.40	
Subscriptions to Proceedings	1,123.03	
Sundries	365.47	6,550.90
SURPLUS		180,394.71
	$200,251.82	$200,251.82

EXHIBIT B

Statement of Profit and Loss for the Year Ended December 31, 1924

PROCEEDINGS				
Sales			$ 1,997.40	
Dues and Subscriptions			14,412.82	
Advertising			3,032.65	
Binding			12.00	
Total Income from PROCEEDINGS			$19,454.87	
Publishers Cost			$16,662.03	
Payments to Authors of Articles			3,663.14	
Honorable Mention Award			75.00	
Total Cost of PROCEEDINGS			$20,400.17	
Loss on PROCEEDINGS (Excluding overhead)			$ 945.30	
INSTITUTE PUBLICATIONS				
Sales		$39,365.68		
Inventory—January 1, 1924	$30,994.90			
Purchases from printers	22,413.02			
	$53,407.92			
Less: Inventory December 31, 1924	32,621.36			
	$20,786.56			
Payments to authors and revisors	1,761.47			
Cost of Books sold	$22,548.03	22,548.03		
		$16,817.65		
Less: Contingent Profit		6,728.97		
Gross Profit (Excluding Overhead)		$10,088.68		$10,088.68
PURCHASED BOOKS				
Sales		$ 5,102.01		
Inventory—January 1, 1924	$ 611.90			
Purchases from Publishers	3,327.43			
	$ 3,939.33			
Less: Inventory December 31, 1924	157.92	3,781.41		
Gross Profit (Excluding Overhead)		$ 1,320.60		1,320.60
			$ 945.30	$11,409.28
Loss on PROCEEDINGS (Excluding Overhead)			945.30	945.30
Gross Profit from Operations (Excluding Overhead)				10,463.98
OVERHEAD OPERATING EXPENSE				
Postage, Express and Hauling			$ 1,123.47	
Office Expense			832.55	
Moody's Service			120.00	
Salaries			10,870.00	
Board Meetings			1,379.60	
Advertising			150.70	
Cost of Collection—Foreign checks			12.31	
Insurance			21.28	
Depreciation (Furniture and Fixtures)			227.99	
Total Operating Expense			$14,737.90	
OTHER INCOME				
From Interest				6,980.67
Profit—Bond transactions				747.50
Net Profit for year			3,454.25	
			$18,192.15	$18,192.15

EXHIBIT C

Comparative Balance Sheet for the Two Years Ended

	DECEMBER 31, 1923		DECEMBER 31, 1924	
ASSETS				
CASH in Bank	$ 28,599.50		$ 38,576.76	
ACCOUNTS RECEIVABLE	6,490.83		9,204.58	
BONDS	113,713.34		116,165.84	
INVENTORY	31,844.61		33,639.98	
FURNITURE and FIXTURES	2,239.55		2,051.93	
PREPAYMENTS	840.57		612.73	
LIABILITIES				
ACCOUNTS PAYABLE		$ 2,466.27		$ 6,577.24
PREPAYMENTS		5,539.53		6,550.90
DEFERRED CREDITS—"Contingent Profits"				6,728.97
SURPLUS		*175,722.60		180,394.71
	$183,728.40	$183,728.40	$200,251.82	$200,251.82

* Including Reserve Fund for Life Membership, $6,450.00.

EXHIBIT D

Comparative Profit and Loss for the Two Years Ended

	DECEMBER 31, 1923		DECEMBER 31, 1924	
PROCEEDINGS				
Sales		$ 391.75		$ 1,997.40
Dues and Subscriptions		14,514.23		14,412.82
Advertisements		2,760.93		3,032.65
Binding		36.00		12.00
Income from PROCEEDINGS		$17,702.91		$19,454.87
Publishers Cost	$17,011.12		$16,662.03	
Payments to authors—articles	3,984.06		3,663.14	
Prize Essay Medal	26.45			
Prize Essay Award	275.00			
Honorable Mention Award			75.00	
Total Cost of PROCEEDINGS	$21,296.63		$20,400.17	
Loss on PROCEEDINGS		3,593.72		945.30
	$21,296.63	$21,296.63	$20,400.17	$20,400.17

(Continued on next page)

(Continued from preceding page)

	DECEMBER 31, 1923		DECEMBER 31, 1924	
INSTITUTE PUBLICATIONS				
Sales		$33,852.36		$39,365.68
Inventory—January 1	$37,605.02		$30,994.90	
Purchases from printers	17,800.12		22,413.02	
	$55,405.14		$53,407.92	
Inventory—December 31	38,694.90		32,621.36	
	$16,710.24		$20,786.56	
Royalty to authors of books	2,359.33		1,761.47	
Total Cost of Sales	$19,069.57		$22,548.03	
Contingent Profit	none		6,728.97	
Profit on Sales—Excluding Overhead	14,782.79		10,088.68	
	$33,852.36	$33,852.36	$39,365.68	$39,365.68
PURCHASED BOOKS				
Sales		$ 3,264.68		$ 5,102.01
Inventory—January 1	$ 951.86		$ 611.90	
Purchases from other Publishers	2,087.15		3,327.43	
	$ 3,039.01		$ 3,939.33	
Inventory—December 31	611.90		157.92	
	$ 2,427.11		$ 3,781.41	
Profit on Sales—Excluding Overhead	837.57		1,320.60	
	$ 3,264.68	$ 3,264.68	$ 5,102.01	$ 5,102.01
PROFIT				
Institute Publications		$14,782.79		$10,088.68
Purchased books		837.57		1,320.60
Interest on investments and banks		6,093.96		6,980.67
Bond transactions				747.50
LOSS				
Proceedings	$ 3,593.72		$ 945.30	
OVERHEAD and OPERATING EXPENSE				
Postage, Express and Hauling	1,681.12		1,123.47	
Office Expense	622.33		832.55	
Moody's Service			120.00	
Salaries	11,557.50		10,870.00	
Board Meetings	1,223.52		1,379.60	
Cost Collection (Foreign checks)	16.06		12.31	
Advertising	509.83		150.70	
Insurance	27.50		21.28	
Depreciation (Furniture and Fixtures)	248.84		227.99	
Total Overhead and Operating Expense	$15,886.70		$14,737.90	
Total Overhead and Operating Expense and Loss Proceedings	$19,480.42		$15,683.20	
Total Profit		$21,714.32		$19,137.45
Net Profit	2,233.90		3,454.25	
	$21,714.32	$21,714.32	$19,137.45	$19,137.45

PUBLICATIONS
U. S. NAVAL INSTITUTE

NAVAL LEADERSHIP

Naval Leadership: with Some Hints to Junior Officers and Others. 2nd Edition, revised 1925.

Containing some 200 pages of clear type on good paper, in a neat and durable fabrikoid binding, in a size convenient for the pocket, approximately 4½x7⅛". $1.50 postpaid.

NAVAL COMMUNICATIONS

Notes on Naval Communications. 2nd Edition, 1924.

Compiled and revised by Lieut. A. C. Kidd, U. S. Navy. The book contains the latest on communications, and is a necessity for those studying for promotion. 160 pages. $1.30 postpaid.

LAW

International Law for Naval Officers, 1924.

By Comdr. C. C. Soule, U. S. Navy, and Lieut. Comdr. C. McCauley, U. S. Navy. 148 pages. $2.00 postpaid.

Constitutional Law. Reprinted 1924 with slight additions.

By H. J. Fenton, M.A., LL.D. 351 pages. $2.25 postpaid.

NAVIGATION

Navigation, 1922.

By Lieut. Commanders E. A. Lofquist, and A. M. R. Allen, U. S. Navy. 508 pages, illustrated, $5.65 postpaid.

Navigation and Compass Deviation, 1918.

By Comdr. W. C. P. Muir, U. S. Navy. 765 pages. $4.20 postpaid.

Practical Manual of the Compass, 1921.

By Captain Harris Laning, U. S. Navy, and Lieut. Comdr. H. D. McGuire, U. S. Navy. 234 pages, illustrated, $3.90 postpaid.

Celo-Navigation, 1924.

By Commander Benjamin Dutton, U. S. Navy. Containing methods and problems for use of the **new method of reckoning time.** For use especially with *Navigation, 1922.* Suitable for use with any navigation textbook. Cloth, 69 pages. Price $1.25 postpaid.